WOOD HEATING CONVERSION STUDY FOR RAE EDZO, N.W.T.

WOOD HEATING CONVERSION STUDY

FOR RAE EDZO, N.W.T.

Prepared for:

Incorporated Hamlet of Rae Edzo

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With a contribution from:

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ABSTRACT

This project assessed the technical and economic feasibility for the widespread conversion of heating systems in the community of Rae Edzo, N.W.T. to the use of wood fuel as a primary heating source. Present and projected fuel consumption quantities were identified. The capital and operating costs for the installation of appropriate wood burning equipment were assembled for the J. Bruneau School, the Cottage Hospital, Nishi Khon Centre commercial complex, and a variety of other commercial, municipal and residential buildings. Centralized or district heating systems using wood fuel were considered for a residential district and for various collections of major buildings.

The installation of suitable wood heating equipment is economically viable for the J. Bruneau School, the Cottage Hospital, the Hudson's Bay Co. store, and in typical residential dwellings. A district heating system including the Nishi Khon Centre and some nearby loads is marginally viable.

The community possesses the skills and infrastructure to sustain the predominant use of wood fuel in the community. The successful wood conversion program is forecast to inject $1,650,000 into community circulation by 1988 and account for 62,000 man-hours of employment over the period.

EXECUTIVE SUMMARY

The feasibility of converting the various building heating systems in Rae Edzo, N.W.T. to use wood as the primary fuel source is assessed in this project. The present fuel oil consumption represents a funds outflow from the community of approximately $450,000 per year. The use of wood fuel, harvested by local contractors and residents, represents a capture of a portion of this amount for the enhancement of the local economy. The use of wood fuel implies fossil fuel energy conservation, and is consistent with the principles of community self-sufficiency and living from the renewable resources of the land - concepts akin to the traditions of the predominantly Dogrib native population.

The project was initiated by a systematic examination of the major buildings and heating loads in the community. The present fuel consumption quantities were collected. The requirements and general suitability for the addition of wood burning heating equipment were assessed. In keeping with the requirements of the building owners or occupants, wood burning appliances were considered as additions to present oil fired heating equipment, with the oil heaters intended to remain in place for stand-by service.

Various types of wood burning appliances, most suitable for use in each of the candidate buildings, were identified. Depending on the specific building, hot water boilers, combination wood/oil furnaces, stand-alone wood furnaces, or add-on wood furnaces, were designated as the most suitable equipment for the application.

An economic analysis of the viability of many different buildings, fitted with appropriate wood heating systems, was undertaken. The analyses assembled capital costs for conversion, incremental operating costs, computed fuel wood requirements, fuel oil savings and net annual cost savings due to each conversion prospect. A community wood conversion plan was developed to guide the installation of wood burning equipment in viable cases, and the preparation of the community to accommodate the widespread use of wood fuel as a heat source. The conversion program

can be easily completed prior to 1988. Community issues and constraints relating to the adoption of wood fuel were investigated and reported.

The Rae Edzo community presently consumes approximately 1,100,000 litres of fuel oil per year and 1,250 cords of wood. The wood fuel estimate is a tenuous one based upon vague reports on community consumption habits. In the absence of wood conversion initiatives the volume of wood fuel used for heating and cooking purposes is expected to slightly drop in the future.

The installation of modern airtight wood stove equipment in residential dwellings is expected to cost typically $2,300 per installation. The savings possible from elimination of fuel oil expenditures permits recovery of this investment in four years.

The installation of forced air wood furnace equipment in typical residential settings costs on the order of $5,100 per installation. This investment is recovered typically in six years.

The installation of a self-contained wood boiler facility adjacent to the Jimmy Bruneau School, to substitute for the present fuel oil boiler operations is the most attractive large project in the community. Capital investment in the project may be recovered in less than 4.0 years. The facility is forecast to consume 350 cords of airdried jack pine wood chip fuel per year.

The Hudson's Bay Co. store, the Cottage Hospital, and a Hamlet owned equipment garage were also judged to be viable candidates for wood fired heating systems.

A number of central or district heating systems using a wood boiler facility were considered. A system serving 25 - 30 residences in Rae was forecast to not be viable. A system serving the Nishi Khon Centre and certain nearby buildings is marginally attractive, pending further consideration of the Nishi Khon Centre operation.

The most sensitive factor influencing project viability for wood conversion projects is the amount and cost of labour resources to tend the heating system. Automated fuel handling equipment and occasional daytime supervision only is generally necessary to preserve project economics.

The community is quite supportive toward a significant wood conversion program. No major community infrastructural development is required to sustain a large wood fuel heating program. Yellowknife tradesmen resources are likely required to assist with new equipment installation activities.

The successful conversion program is expected to increase community wood fuel use to about 2,500 cords/year in 1988. A total capital investment, from present to 1988, of $1,700,000 is forecast to install wood burning systems. 62,000 man-hours of work from present to 1988 is forecast to install and provide wood fuel for these systems, with an injection of $1,650,000 into the local and regional economy.

The conversion program is based on the conversion of all existing public housing units to the use of manually fed wood furnaces. The program includes the installation of similar wood furnaces in all new public and private residential dwellings. A number of commercial/institutional/municipal buildings are embodied in the conversion program, namely the J. Bruneau School, Cottage Hospital, Hudson's Bay Store, and Hamlet Garage.

A critical assumption to the viability calculations and the projections of economic impact is that one cord of wood fuel can substitute 616.6 litres of fuel oil. If wet wood fuel is consumed, or wood appliances are not properly maintained, relatively more wood fuel is required, reducing financial viability in the particular installations and causing an increase in the labour hours generated in wood harvesting.

ETUDE DE CONVERSION AU CHAUFFAGE AU BOIS

Rae-Edzo (Territoires du Nord-Ouest)

Résumé

La présente étude évalue la faisabilité de convertir au bois comme source principale de combustible les différents systèmes de chauffage des locaux à Rae-Edzo dans les Territoires du Nord-Ouest. La consommation actuelle de mazout représente une sortie de fonds d'environ 450 000 $ par an pour la collectivité. L'utilisation de bois, récolté sur place par des entrepreneurs et habitants de la localité, représenterait l'injection dans l'économie locale d'une part de cette somme. L'emploi du bois comme combustible permet de conserver les sources d'énergie fossile et concorde avec l'autarcie de la collectivité et la notion de vivre à même les ressources renouvelables de leurs terres - notions proches des traditions de la population autochtone, majoritairement composée de Flancs-de-Chien.

Le projet a commencé par un examen systématique des immeubles et des charges de chauffage de la collectivité. On a recueilli des données sur la consommation actuelle de combustible et on a évalué les besoins et l'adaptabilité générale du matériel de chauffage alimenté au bois. Compte tenu des besoins des propriétaires ou des occupants des immeubles, l'option étudiée consiste à installer des matériels de chauffage alimentés au bois à titre de chauffage d'appoint et à retenir les calorifères actuels au mazout à titre de moyens de seccurs.

Selon l'usage prévu de chacun des immeubles, différents types d'appareils alimentés au bois ont été retenus, à savoir des chaudières, des calorifères mixtes bois/mazout, des calorifères au bois, des calorifères d'appoint alimentés au bois, et des poêles à bois.

Des analyses de la rentabilité des différents systèmes de chauffage au bois installés dans les immeubles en question ont été faites. Ces analyses tiennent compte des coûts d'immobilisation entraînés par la conversion, des frais marginaux d'exploitation, des estimations des besoins en bois de chauffage, des économies en mazout et des économies annuelles nettes découlant de la conversion. On a élaboré un plan de conversion au bois pour toute la collectivité afin de servir de guide à l'installation de matériels brûlant du bois dans les cas où c'est rentable, ainsi que pour préparer les membres de la collectivité à s'adapter à une utilisation à grande échelle du bois de chauffage. Le programme de conversion peut facilement être achevé avant 1986. L'étude se penche aussi sur les préoccupations et les contraintes constatées au sein de la collectivité en ce qui concerne l'adoption du bois de chauffage.

Le hameau de Rae-Edzo consomme actuellement environ 1 100 000 litres de mazout et quelque 1 250 cordes de bois par an. L'estimation du volume de bois est très approximative et se fonde sur des renseignements assez vagues sur les habitudes de consommation de la collectivité.

En l'absence d'initiatives de conversion au bois, il est prévu que le volume de bois utilisé pour le chauffage des locaux et la cuisson diminuera sensiblement à l'avenir.

L'installation de poêles à bois modernes, étanches à l'air, dans des logements coûterait quelque 2 300 $ par installation. Les économies réalisables par l'élimination de la dépense actuelle consacrée au mazout permettraient de récupérer l'investissement en quatre ans.

L'installation de calorifères à air pulsé alimentés au bois dans un logement type coûterait environ 5 100 $ par installation. Généralement, le délai de récupération est de six ans.

L'installation d'une chaudière autonome alimentée au bois pour remplacer la chaudière actuelle au mazout de l'école Jimmy Bruneau est le projet le plus intéressant décelé dans la collectivité. L'investissement serait récupérable dans moins de quatre ans. L'installation consommerait 350 cordes par an de copeaux de pin gris séché à l'air.

Le magasin de la Baie d'Hudson, l'hôpital, un garage appartenant au hameau sont tenus pour des locaux où l'installation de systèmes de chauffage au bois serait rentable.

L'étude a examiné les possibilités d'un certain nombre de systèmes de chauffage central ou urbain mettant en oeuvre une chaudière alimentée au bois. Un système desservant les 25 à 30 logements à Rae-d'Edzo a été jugé non rentable. Un système pour le Nisni Khon Centre et certains immeubles avoisinants serait toute juste rentable; il faudrait étudier de plus près le fonctionnement du Centre pour en établir la rentabilité avec certitude.

Le facteur le plus délicat qui entre en jeu dans la détermination de la rentabilité du projet de conversion au bois du matériel de chauffage est le coût de la main-d'oeuvre nécessaire pour exploiter le système de chauffage. Un matériel automatique de manutention du combustible et une surveillance occasionnelle de jour suffisent en général pour préserver la rentabilité du projet.

La collectivité appuie en général assez fortement la conversion du chauffage au bois. Il n'est pas nécessaire de prévoir l'aménagement d'aucun élément important d'infrastructure additionnelle pour mettre en oeuvre un programme de chauffage au bois. Il faudra cependant faire appel à des hommes de métier de Yellowknife, lors de l'installation du matériel.

Un programme de chauffage au bois, s'il réussit, porterait la consommation de bois de chauffage de la collectivité à quelque 2 500 cordes de bois par an en 1988. L'investissement total, jusqu'en 1988, serait de 1 700 000 $ pour l'installation des matériels alimentés au bois. On prévoit qu'il faudra 62 000 heures-personnes jusqu'en 1988 pour assurer l'installation et la récolte de bois, et qu'une somme de 1 650 000$ serait injectée dans l'économie locale et régionale.

Le programme de conversion est fondé sur la conversion des systèmes de toutes les unités d'habitation publiques qui existent à l'heure actuelle en systèmes de chauffage au bois alimentés à la main. Un nombre d'édifices commerciaux/institutionnels/municipaux tels que l'école J. Bruneau, le magasin de la Baie d'Hudson, l'hôpital et un garage appartenant au hameau font partie du programme de conversion.

L'hypothèse qu'une corde de bois pour des fins de chauffage peut remplacer 616,6 litres de mazout est à la base des calculs et des prévisions de la rentabilité. Lorsque le bois de chauffage mouillé est consommé, ou lorsque le matériel de chauffage au bois n'est pas entretenu convenablement, une quantité plus élevée de bois de chauffage est requise, ce qui a pour conséquence de réduire la rentabilité de l'installation de ces systèmes et de produire une augmentation des heures de travail pour la récolte du bois.

1.0 INTRODUCTION

The community of Rae Edzo presently employs fuel oil as the primary heating energy source. Commercial, municipal and institutional buildings burn fuel oil exclusively, in furnaces and hot water boiler units. The majority of residential housing in the community is public housing owned by the NWT Housing Corporation of the GNWT. Virtually all public housing units are fitted with oil fired furnaces. Some occupants use wood for supplementary heating or aesthetic effect in wood stoves, and use wood in wood fired cook stoves. The minority of the residential dwelling stock, owned privately, use both oil and wood fuel for heating, with wood used to provide the vast majority of heat energy.

The prospects for energy cost savings and the prospects for increased community employment from wood harvesting prompted the Hamlet to support this study intended to assess the technical and economic feasibility of the widespread conversion of heating systems in the community to the use of wood fuel. The salient elements of the Terms of Reference for the work included an examination of the heating systems in the community to establish the technical requirements for their conversion or substitution to wood fuel, and to identify preferred candidates for conversion. The existing and projected fuel consumptions in the community were to be documented. Appropriate wood fired heating systems for the various building installations were to be identified and their economic viability established. An examination of the community attitudes, community infrastructure and the community broad economic benefits resulting from widespread wood conversion was required. A plan to lead the conversion of heating systems to wood fuel, in cases where viability is apparent was required. This document represents the final report on the project, describing the work completed and the results obtained.

The project excluded detailed consideration of the availability or inventory assessment of the wood fuel supply in the region. The work also excluded detailed investigation, definition and impact assessment of the use of various energy conservation measures possible to reduce building heating costs.

The report is prepared with quantitative information expressed in metric and imperial units. Imperial units were employed regarding heating equipment capacities, heating loads, wood fuel quantities, etc., i.e., units most familiar to the community residents.

The report is organized to logically address and sequentially report on the various dimensions of the project. The existing building stock, to which this study is addressed, is described in Chapter 2,0. Heating systems are specified and the general suitability of various buildings to the use of wood fuel are assessed.

The economic viability of converting particular candidate buildings is dependent on their present and projected fuel oil consumption. Fuel oil consumption data is assembled in Section 3.0.

Different types of wood burning appliances are required to most closely fit the circumstances of the various buildings and residences. Suitable appliances including wood furnaces, combination wood/oil units, small scale automatic fuel stokers, and wood boiler plants are described in Chapter 4.0 for possible use in the community. The appropriate wood burning equipment is matched to particular candidate buildings in Chapter 5.0 and the capital costs to install wood burning heating systems are assembled.

The economic viability of installing these heating systems is dependent on the ongoing operating costs of the new installations, the amount of cost savings possible due to the use of the cheaper wood fuel, and upon the long term sustainable cost of wood fuel delivered to the user. These costs are estimated for the candidate buildings in Chapter 6.0, and the economic attractiveness computed. The sensitivity effects of various factors on the viability of each conversion opportunity are also quantified.

The success of a program to convert the community to the widespread use of wood fuel is dependent on much more than the economic gains possible.

The community residents and building owners must want to make the change to wood fuel, people must be willing to harvest wood fuel for personal use or sale, other aspects of community infrastructure must be in place or developed. These community related issues are addressed in Section 7.0.

A broad range of other constraints exist to prevent or retard the success of a wood conversion program. These constraints are discussed in Section 8.0. One possible constraint is the availability of funds to undertake the capital investments required to buy new heating equipment, start up wood harvesting businesses or secure skills training. Forms of financial assistance are identified and described in Section 9.0.

The process to convert to wood fuel will not occur simply because this report suggests that specific conversion opportunities are economically viable, and other related factors are supportive. A Conversion Program Plan is required to actively lead the conversion process and break down the recognized barriers to its success. The steps of a suitable Conversion Program Plan are outlined in Section 10. The economic consequences and impact of the successful implementation of the Conversion Program are projected also.

The various conclusions reached through the course of this assignment are summarized in Section 11.

2.0 COMMUNITY BUILDING AND HEATING SYSTEMS

2.1 GENERAL

The first step in the planning process toward a wide spread conversion program is to establish the current stock of community buildings and the heating systems in place. Descriptions of the various buildings, together with basic requirements to convert the buildings to use some form of wood heating appliance, are presented in this section. The community buildings are partitioned into three classes:

a) Commercial Buildings, used by the tenants as a place of business to earn income. The Nishi Khon Centre in Rae is the largest commercial building in the community. Various government (institutional) services are also offered within the building from space rented from the local building owner.

b) Municipal and Institutional Buildings These buildings are owned and operated by the Hamlet or a government agency, and are used as part of delivery of services to the community at large.

c) Residential Buildings These buildings include apartments, duplexes and single family dwellings used for domestic residence.

Most commercial, municipal and institutional buildings were visited to document present conditions and assess the suitability for wood appliance installation. A representative number of residences were visited to establish the range of structural conditions, heating systems and potential for wood conversion. Descriptions from the individual visits are assembled in Appendix 4.0 of this report.

Future prospects for building construction in each of the three categories were identified as possible. Individual projects on the horizon are also outlined in Appendix 4.0.

The current building stock of commercial, municipal and institutional buildings are summarized in Tables 2.1/1 and 2.1/2 on the following pages.

Residential housing in Rae Edzo can be segregated into three types:

a) private homes

b) older public housing built as part of the NWTHC Northern Rentals program

c) newer public housing

Public housing is administered by the local tenant association - the Rae Edzo Housing Association. The administration manages the community public housing budget, where house rents and the NWT Housing Corporation subsidies represent incomes, and housing maintenance and repair expenses represent costs. The NWT Housing Corporation is supported 50% by the federal Central Mortgage and Housing Corporation (CMHC) and the rest by the GNWT.

Public housing tenants pay a monthly rental fee that is independent of the actual electricity and fuel oil consumption for the house. Accordingly, the incentives and penalties for non-efficient energy use in the homes do not exist for the occupants. Private housing owners are obviously responsible for their own costs for home heating. Some families receive fuel as part of social assistance payments.

Public housing rental agreements in the near future are expected to include user pay clauses for electricity use. "User pay" for heating fuel costs have been suggested for the future also.

In recent years, the Housing Corporation has purchased wood stoves for newly built public housing, if the tenants have so requested.

There is a trend in the community away from public housing toward home ownership. Increased incomes and job opportunities coupled with an increasing pride in ownership, desire for self-sufficiency, and desire to have tangible assets to pass on to children, all have contributed to home ownership demand.

The existing complement (1983) of residential dwellings consists of:

o	Apartments	nil
o	Private Homes	85 est.
o	Northern Rentals public housing	107
o	other "New" public housing	43
		235 units

A number of these dwellings were visited to establish the types and range of heating systems found in this building sector. The "new" public housing units feature three interior layouts. All units for a particular layout (eg.: 2, 3, or 4 bedroom) are identical. Typical dwellings are noted in Table 2.1/3.

Northern Rental public housing units are homes built in the 1960's and early 1970's, and are most often found in Edzo. The majority of the units have undergone major structural renovations at least once in their lifetime to replace insulation, replace all interior surfaces, and perform other repairs as required. The Northern Rental units are reported to be generally the same in terms of size, basic construction and exterior. All units are equipped with oil furnaces. Some of the older units have supplementary wood stoves or heaters. All of these wood heaters are scheduled for retirement, as part of the building rehabilitations by late 1985. Typical Northern Rental homes are descirbed in Appendix 4.0.

The most variance in building construction appears in private housing. Older private homes are generally in poor condition, thermally unsound, and have inadequate heating systems by modern standards. Homes are constructed in all shapes and sizes from small, cottage style shelters to larger modern dwellings, constructed following CMHC approved codes.

The range of structures is typified by the home visit descriptions prepared in Appendix 4.0.

The assignment could not afford the examination of every dwelling in the community. Instead, an illustrative sample of units were examined, and the

knowledge of housing association and Hamlet personnel was applied to draw the required conclusions for this work to proceed. The key questions answered in this regard were:

a) What is the total fuel oil and wood fuel consumption in residential dwellings?

b) What is the present lifetime for the existing building stock?

c) What is the present type of heating equipment employed (general size, type, installation arrangement, etc.)?

d) What are the technical requirements to convert residential dwellings to use wood fuel as the total heat source.

Exhaustive building residence examinations would not markedly enhance the community conversion plan (Section 10.0) required to induce widespread use of wood fuel.

Virtually every private dwelling has a wood stove. In recent years a number of dwelling owners have upgraded their wood heating units to modern air tight stoves. Approximately 65 units still remain to be upgraded to modern higher efficiency stoves.

LOCATION	SIZE (sq. ft.)	TYPE	PRESENT FUEL	PRESENT HEATING EQUIPMENT	TOTAL HEATING CAPACITY	SUGGESTED WOOD BURNING APPLIANCE	CONVERSION SUITABILITY
COMMERCIAL					NOTE (1)	NOTE (2)	NOTE (3)
1. Arny General Stores Ltd. - store & gas bar	1,500	wood frame	fuel oil	--	est. 150,000 BTU/hr	--	D
2. Rae Cafe	1,200	doublewide industrial trailer	fuel oil	--	est. 130,000 BTU/hr	--	D
3. Hudson's Bay Co. - store	4,000	wood frame	fuel oil	Powermatic hot air furnace	250,000 BTU/hr	B, C	A
- manager's house	800	wood frame	fuel oil	Olsen hot air furnace	105,000 BTU/hr	--	--
- staff trailer	240	trailer	fuel oil	--	est. 80,000 BTU/hr	--	--
- warehouse	400	wood frame	--	--	--	--	D
4. Nishi Khon Center	20,000	wood frame	fuel oil	2-Weil McLean hot water boilers	2 x 1,008,700 BTU/hr	D	B ∞
5. Ft. Rae Handicraft Center	875	wood frame	fuel oil	--	est. 120,000 BTU/hr	--	--
6. J. B. Gas Bar	350	wood frame	fuel oil	Moffat hot air furnace	110,000 BTU/hr	B, C	C
7. Nishi Khon Forest Service	450	wood frame	fuel oil	--	est. 120,000 BTU/hr	--	--
8. Rix Trucking	1,400	metal frame	wood & fuel oil	wood stove, hot air furnace	--	B	C
9. Development Corporation Warehouse	2,500	wood frame	fuel oil	Two Olsen hot air furnaces	250,000 BTU/hr	B	C

Table 2.1/1 RAE - EDZO COMMUNITY -- COMMERCIAL BUILDINGS

Notes

(1) The heating capacity of existing equipment was estimated in cases where actual figures were not obtained. Little correlation between furnace size and building area was found in the community. This may be due to the broad range in heat retaining qualities of the structures, and the possibility that used furnace units are re-installed in different applications over time without careful regard for operating duty cycle. The estimates given are guesses based on observations in the community.

(2) A = Air Tight Wood Stove
B = Wood Furnace
C = Wood/Oil Furnace
D = Wood Boiler

(3) A = Immediate Conversion
B = Good Prospect
C = Marginal Candidate
D = Not Recommended

LOCATION	SIZE (sq. ft.)	TYPE	PRESENT FUEL	PRESENT HEATING EQUIPMENT	TOTAL HEATING CAPACITY	SUGGESTED WOOD BURNING APPLIANCE	CONVERSION SUITABILITY
					NOTE (1)	NOTE (2)	NOTE (3)
INSTITUTIONAL & MUNICIPAL							
1. Rae/Edzo Hamlet Buildings							
a) workshop	2,100	log & wood frame	fuel oil	Olsen Inc. hot air furnace	est. 161,000 BTU/hr	B	C
b) old community hall	2,800	wood frame	fuel oil	two Olsen Inc. hot air furnaces	233,000 BTU/hr	B	D
c) new equip't garage	3,750	steel	fuel oil	four Powermatic hot air furnaces	560,000 BTU/hr	D	B
d) Edzo Firehall	1,500	wood frame	fuel oil	--	est. 120,000 BTU/hr	--	--
e) Rae Firehall	1,400	steel	fuel oil	Olsen Inc. hot air furnace	115,000 BTU/hr	B	C
f) Sec'y Manager house	900	wood frame	fuel oil	Olsen Inc. hot air furnace	108,000 BTU/hr	C	C
2. RCMP Facilities						A,B,C,D	B
a) detachment office	1,800	wood frame	fuel oil	--	est. 125,000 BTU/hr		
b) NCO house	1,200	wood frame	fuel oil	--	est. 110,000 BTU/hr		
c) workshop	600	wood frame	fuel oil	--	est. 90,000 BTU/hr		
d) duplex housing	2,400	wood frame	fuel oil	--	2 x 110,000 BTU/hr est.		
e) doublewide house tr	1,680	wood frame	fuel oil	--	est. 125,000 BTU/hr		
f) house trailer	840	wood frame	fuel oil	--	est. 90,000 BTU/hr		
3. J. Bruneau School	60,000	concrete block	fuel oil	Cleaver Brooks hot water boilers	12,500,000 BTU/hr	D	B
4. Cottage Hospital	4,800	wood frame	fuel oil	two Weil-McLean hot water boilers	520,000 BTU/hr	D	B
5. Roman Catholic							
- church	2,800	wood frame	fuel oil	--	est. 200,000 BTU/hr	--	D
- mission	2,800	wood frame	fuel oil	Anthes hot air furnace	172,000 BTU/hr	A,B	A
- Grey Nuns residence	1,200	wood frame	wood, oil	--	est. 100,000 BTU/hr	--	--

Notes - As per Table 2.1/1

Table 2.1/2 RAE - EDZO COMMUNITY -- INSTITUTIONAL AND MUNICIPAL BUILDINGS

RESIDENCE	QUANTITY	SIZE (FT^2)	CONSTRUCTION TYPE	PRESENT FUEL	HEATING EQUIPMENT	HEATING CAPACITY	SUGGESTED WOOD HEATING APPLIANCE	CONVERSION SUITABILITY
"NEW" PUBLIC HOUSING								
4 bedroom units	18 units		wood frame	fuel oil			A, B	A
ex. #1		770	wood frame	fuel oil	Enterprise oil furnace	139,000 BTU/hr.	A, B	A
3 bedroom units	15 units		wood frame	fuel oil			A, B	A
ex. #1		576	wood frame	fuel oil	Coleman Mdl 971	80,000	A, B	A
ex. #2		770	wood frame	fuel oil	Olsen Inc. oil furnace	115,000 BTU/hr	A, B	A
2 bedroom units	10 units		wood frame	fuel oil			A, B	A
ex. #1		770	wood frame	fuel oil	Enterprise oil furnace	139,000 BTU/hr	A, B	A
NORTHERN RENTAL PUBLIC HOUSING - 107 units								
Units with oil furnaces only	86 units						A, B	A
ex. #1		770	wood frame	fuel oil	Moffat	91,000	A, B	A
ex. #2		770	wood frame	fuel oil	Olsen Inc. oil furnace	94,000 BTU/hr	A, B	A
Units with primary oil and supplementary wood heaters	21 units*	700-800	wood frame	fuel oil & wood				
	*all scheduled for demolition or extensive rehabilitation by late 1985, and to be heated only by fuel oil							
PRIVATE HOUSING - 85 units								
Units with primary oil and supplementary wood heating	9 units							
ex. #1		450	wood frame	wood and fuel oil	Airtight updraft wood stove Enterprise Foundry oil heater	1-2 cu. ft. firebox	A, B	A
Units with wood heaters heaters only	75 units							
ex. #1		400	wood frame	wood	barrel shaped wood heater	1 cu. ft.	A, B	A
ex. #2		1000	log	wood	airtight wood stove	2-3 cu. ft.		
ex. #3		1000	wood frame	wood	1-cookstove 1-wood heater	1-2 cu. ft. 2-3 cu. ft.	A, B	A
Units with propane	1 unit							
ex. #1		1000	mobile home	propane	furnace	--	(owners' instr...	C
Units with oil furnaces only	-0- units							

Table 2.1/3 RAE - EDZO COMMUNITY -- RESIDENTIAL BUILDINGS - 1983

2.2 TECHNICAL REQUIREMENTS FOR CONVERSION

Each of the community buildings visited were studied to establish the technical requirements to install a suitable form of wood heating appliance. Each of these requirements, and the general findings, are addressed below.

a) Back-up Heat Sources

Most building owners or operators prefer the capability to leave a building unattended for long periods without danger of freeze-up. Also some provision must exist to heat the building while the primary heating unit is out of service for repair. To accomplish these objectives, it is assumed that all existing oil fired equipment in reasonable condition would be kept on hand for back-up service to the primary wood fired heat source. This assumption can be relaxed if a combined wood/oil burning appliance is advocated, or if the wood fired heating system employs automated fuel feed equipment and more than one heating appliance is used.

b) Space Requirements

Additional heating equipment requires physical space to locate the equipment. Consideration must be given to the tie-in to existing heat distribution plumbing or ductwork. The path to deliver wood fuel from an outside stockpile to the wood burning appliance is also a space related concern.

In residential dwellings, air tight wood stoves were sometimes suggested provided the living area was of adequate size. In most cases the existing furnaces were located in a utility area with easy access to the outside to permit the installation of a wood fired furnace or a wood/oil combination.

Municipal, institutional and commercial buildings had oil fired installations in good condition generally. In many cases, a building addition is required to house a wood burning appliance.

c) Chimneys

The flue vent sizes for wood burning appliances differ from similar sized oil burning appliances, since the wood burner must operate with a much higher proportion of excess combustion air. The flue gas temperature in a wood appliance is generally higher than in an oil fired appliance.

In virtually every case, the requirements noted for conversion to wood call for the installation of a new chimney to exhaust flue gases. Existing chimneys for oil appliances are usually too small for combined operation of wood and oil appliances, and adequate clean-out ports to remove creosote are not in place. Appliances require flue vents of the diameters listed in Table 2.2/1.

d) Convertability

This parameter refers to a subjective judgement on the existing heating system of how easy, in a technical sense, the system could be converted or changed to a wood, or wood/oil combination heating system. The expected future life span of the existing equipment is considered. The accessability and complexity of tie in to existing heat distribution plumbing or ductwork are considered. Throughout the inspections no unusual technical problems were identified. Only one or two existing heating systems were in poor condition suggesting replacement.

e) Type of Wood Fired Heating Appliance

The types of appliances considered for installation in any instance were airtight wood stoves, wood fired hot air furnaces with built-in circulation blower, wood fired hot water boilers. Hot water boilers are suggested in cases where existing oil fired equipment are hot water boilers. Combination wood/oil units are suggested if existing oil furnaces are due for replacement, or to avoid adding more space to house a separate wood furnace. Separate wood furnaces are suggested if existing space is available, or the existing oil furnace is in good condition.

Table 2.2/1 FLUE VENT DIAMETERS

MAXIMUM RATED INPUT OF ONE OR MORE APPLIANCES	MINIMUM SIZE OF FLUE*	
	WOOD APPLIANCE	FUEL OIL APPLIANCE
100,000 BTU/hr (30 kw)	6 inches dia. (150 mm)	
175,000 BTU/hr (51 kw)	7 inches dia. (175 mm)	
280,000 BTU/hr (82 kw)	8 inches dia. (200 mm)	
400,000 BTU/hr (117 kw)	9 inches dia. (225 mm)	
500,000 BTU/hr (146 kw)		6 inches dia. (150 mm)
1,000,000 BTU/hr (293 kw)		8 inches dia. (200 mm)
1,200,000 BTU/hr (352 kw)	12 inches dia. (300 mm)	
1,700,000 BTU/hr (500 kw)		10 inches dia. (250 mm)
2,300,000 BTU/hr (675 kw)		12 inches dia. (300 mm)
3,000,000 BTU/hr (880 kw)	18 inches dia. (450 mm)	
4,200,000 BTU/hr (1230 kw)		16 inches dia. (400 mm)
8,400,000 BTU/hr (2600 kw)		20 inches dia. (500 mm)
16,000,000 BTU/hr (4690 kw)	36 inches dia. (900 mm)	

* with approximate metric equivalents

Sources:

National Building Code (wood and oil)

Manufacturers specifications (oil)

f) Suitability

This is a parameter that indicates, for a given building, a subjective judgement, having taken all things into consideration (technical conversion requirements, manner and frequency of use of the building, available manpower, owner attitudes, etc.) of how appropriate this particular building may be for conversion to wood heating. A four point rating system was used

A recommended for immediate conversion
B good prospect for conversion
C marginal candidate for conversion
D not recommended for conversion

The suitability rating was used as the basis for development of the conversion plan, presented in Section 10.

The ratings assigned to the commercial, municipal and institutional buildings visited are tabulated in Tables 2.1/1 and 2.1/2.

A tabulation of suitability ratings for residences visited was not assembled since they only represent a small fraction of the housing stock. In general terms, some form of wood heating installation in all housing is recommended and virtually all homes would be rated as A or B.

Commercial, municipal or institutional buildings were sometimes rated as good prospects (B) as opposed to immediate conversions (A) if more analysis was required beyond the scope of this report, in order to make a final commitment to wood conversion.

2.3 FUTURE BUILDINGS

Municipal and institutional buildings planned for the community in the next five years were identified. Similar buildings for construction further into the future do not appear on agency capital budget plans, and hence long term construction cannot be projected.

Municipal and institutional buildings on the planning horizon are

a) Rae Recreation Complex
   - construction 1984

b) Old Folks Home
   - possible construction 1986

c) Rae Elementary School
   - possible construction 1986

Descriptions of these projects are given in Appendix 4.3.

The Rae Recreation Complex is committed to oil fired boilers for space heating. The Old Folks home planning has partial wood heating under consideration. Plans for the school are not sufficiently advanced.

The future prospects for new commercial businesses or buildings are indeterminable. A road side motel, cafe, gas station near Frank Channel has been pondered in recent years, but concrete plans to proceed with such a project do not exist. Obviously, almost any future building in the community, especially if frequently inhabited, would be a good prospect for a wood fuelled heating system.

Future prospects for residential housing construction may be based on the rate of population growth, rate of replacement of current housing stock, and the impact of major economic development or a resource development project in the community.

Population data from five sources (Ref. 2, 3, 4, 5, 8) were examined. The most accurate community population appears to be a 1980 figure of 1631 people, taken from N.W.T. Health Care Registrations (Ref. 2) and is in close

agreement with a survey by Father Pochat in the community in 1978. Each source predicts a different growth rate: Lutra Associates Ltd. (Ref. 2) predicted 6.4% per 5 years; Peat Marwick (Ref. 3) predicted 21.3% per 5 years; the census 1976 - 1981 indicates a growth rate of 19.0% actually occured over the 5 year period 1976 - 1981.

Recent survey data from the GNWT regional planner indicates a 1983 population of 1550 - 1600 persons in the Rae Edzo community, suggesting the population has remained stable in the last few years. Due to the wide variance in projected growth rates cited by others, and the recent actual low growth rate in the community, the Lutra rate of 6.4% per 5 years is selected here. The projected population is indicated in Table 2.3/1. The housing requirements to support this population are estimated based on a living density of 6.0 people per home (presently the density is 1600 people per 235 homes = 6.8 people per home; 50% of the homes have 6+ inhabitants, 15 - 20% have 10+ inhabitants).

New houses will be constructed to replace existing homes as well as to meet the increased population needs. The current housing stock has demonstrated a useable lifetime of approximately 20 years. (Hopefully the newer homes are better quality units with 30 - 40 years lifetimes.) Accordingly, the projection for new housing units, in Table 2.3/1 factors in the gradual replacement of 90% of the current housing stock over the next 20 years.

Table 2.3/1 RAE-EDZO POPULATION AND HOUSING PROJECTIONS

YEAR -	1983	1988	1993	1998	2003
Population	1600	1702	1811	1927	2050
Houses Required	235	270 *	301	321	342
New Home Starts		87	83	73	74

* Departed from the 6.0/house rule to smooth the transition from the present 6.8/house density.

The results of the projection indicate the community population will exceed 2000 people in 20 years. Approximately 80 housing starts per 5 year period are required to support the population.

3.0 COMMUNITY HEATING FUEL CONSUMPTION

3.1 GENERAL

Heating fuel consumption information for the community was gathered from a variety of sources. Residential housing fuel consumptions for public housing were identified from the Rae Edzo Housing Association - the local administrator for the N.W.T. Housing Corporation. The records of the local fuel oil supplier provided information on commercial and some private building heating requirements. Operators of individual buildings or groups of buildings were contacted to review any records on hand. The Chief Jimmy Bruneau School is commended for the detailed energy consumption records maintained. Power and fuel oil consumption per month, for many years, were available. Correlations of daily use to outside air temperature were partially completed.

In general terms, however, the availability of fuel consumption data and awareness of consumption amounts was poor. The operators or inhabitants of many buildings (especially residential, municipal and some institutional) are not accountable for fuel consumption. The fuel is purchased and paid for by one person or department, and consumed by another.

The actual fuel consumption data collected from the various sources is assembled in the following section. The data is extended (fill in the gaps) in Section 3.3 to estimate the total current fuel energy consumption, and is projected in time to predict future fuel oil consumption in the absence of a significant wood heating conversion program.

Aggregate energy consumption of all types for the total community was estimated by the N.W.T. Science Advisory Board. These figures are reproduced in Appendix 2.0.

3.2 CONSUMPTION DATA

Actual heating fuel oil consumption data collected from the various building owners or operators are assembled in Tables 3.2/1, 3.2/2, and 3.2/3.

Fuel records, in general, suffer some important inadequacies.

1. Since records are generally fuel purchase invoices, the amount of fuel on hand in the tank at the start of, and end of a monitoring period is unknown. This can distort the actual fuel consumption amount for the period by up to one supply tank full (whatever volume the particular installation's fuel tank holds) resulting in an error of, say, 15%.

2. Records from various sources never cover the same time periods. Months are occasionally missed out and data is interpolated, or substituted from other years to fill in the void. The annual consumption is therefore the so-called composite year amount.

3. Year-to-year variations in weather affect fuel consumption. Unusually warm winters, or cold winters distort annual data from the long term mean.

4. Occasionally fuel consumption in volume units (litres) is derived from fuel costs. Errors result when fuel costs are not accurately applied or when costs change during the course of the monitoring period.

5. Fuel consumption is also significantly dependent on the physical condition of a particular building, the operating practices to maintain the internal temperatures, and the amount the building is used. All of these factors can change quickly and cause abrupt changes in fuel consumption.

All of this suggests that aggregate fuel data can only be accurate over the long term by, say, $\pm$30%.

Table 3.2/1 FUEL OIL CONSUMPTION DATA
RAE-EDZO COMMERCIAL BUILDINGS

BUILDING	CONSUMPTION (Litres)	DATA TYPE
1. Arny's General Stores Ltd.	12,000	estimate
2. Rae Cafe	included in Arny's Gen. Stores	
3. Hudson's Bay Co.	22,800	estimate
4. Nishi Khon Centre	51,728	actual
5. Ft. Rae Handicraft Shop	--	--
6. J. B. Gas Bar	--	--
7. Nishi Khon Forest Service	--	--
8. Rix Trucking	--	--
9. Dev't Corporation Warehouse	included in Nishi Khon Centre	

Actual - from fuel records

Estimate - data derived from owners perceptions or calculation

Approximation - average or round-off of actual data

Table 3.2/2 FUEL OIL CONSUMPTION DATA

RAE EDZO MUNICIPAL AND INSTITUTIONAL BUILDINGS

BUILDING	CONSUMPTION (Litres)	DATA TYPE
1. Rae Edzo Hamlet Buildings	125,000	approximation
- workshop		
- old community hall		
- four bay equipment garage		
- Edzo firehall		
- Rae firehall		
- secretary managers house		
2. RCMP Facilities		
- detachment office	13,800	actual
- NCO house	9,000	actual
- workshop	4,200	actual
- duplex housing	7,600	actual
- doublewide house trailer	7,900	actual
- house trailer	4,800	actual
3. J. Bruneau School	230,000	approximation
4. Cottage Hospital	45,489	actual
5. Roman Catholic		
- church)	16,000	estimate
- mission)		
6. Hamlet Domestic Water Supply Heating	1,500	estimate

Actual - from fuel records

Estimate - data derived from owners impressions or calculations

Approximation - average or round-off figures from actual data

Table 3.2/3 FUEL CONSUMPTION DATA

RAE-EDZO COMMUNITY RESIDENTIAL DWELLINGS

HOUSING UNIT	CONSUMPTION
FUEL OIL - 1982	
Total 107 Northern Rental Public Housing	355,730 litres, or 3325 litres/unit
Total 43 newer Public Housing Units	155,487 litres, or 3616 litres/unit
Total 85 Private Units	Approximately 30,000 litres
FUEL OIL - 1983	
(Rae-Edzo Housing Ass'n Records)	
Total 137	483,386 litres, or 3528 ltres/unit
WOOD FUEL - 1983	
Total Private Use	Approximately 1,100 cords
Total Public Use	Approximately 150 cords

COMMERCIAL BUILDINGS

Fuel consumption information for commercial buildings tended to lump together groups of buildings under one owner into one fuel figure. Since the Rae Cafe and Arny's General Store are owned by the same local businessman, both buildings are treated as one from a fuel billings perspective. The Hudson's Bay Co. consumption figure includes the store, manager's residence, staff trailer and warehouse.

MUNICIPAL AND INSTITUTIONAL BUILDINGS

The Rae Edzo hamlet buildings fuel consumption figure was taken from the audited financial statements covering the calendar year 1982. An aggregate fuel cost figure was available, and was converted back to litres based on prevailing fuel cost rates.

The fuel consumption figure for Jimmy Bruneau School is an averaged figure taken from the more detailed records provided in Appendix 4.3.7.

The domestic water supply in N.W.T. communities often is a major fuel oil consumer, with fuel used to heat the treated water to prevent freeze up of the flow lines in the distribution system. The community of Edzo employs a continuous circulation method to deliver water through underground flow lines to each home or user. Freezing is avoided by keeping the water in motion at all times (electrical energy for pumping is consumed instead of heat energy). The water supply system in Rae consists of a partially piped system to tap houses, and a trucked water service to domestic holding tanks. The water absorbs some heat during the treating process in the treatment plant building but no other heat is applied. The posted fuel consumption figure is the Rae treatment plant space heating consumption, estimated by the operator.

RESIDENTIAL BUILDINGS - PUBLIC HOUSING

Fuel consumption figures from the Rae Edzo Housing Association were assembled to establish consumptions for all forms of public housing. Aggregate

figures presented in Table 3.2/3 suggest the average fuel consumption per dwelling is in the 3300 - 3600 litres/annum range. Public housing wood fuel use is restricted to a small number of older units fitted with wood burning appliances for supplementary space heating or cooking. The housing units are scheduled for demolition or extensive rehabilitation by the end of 1985. Current plans exclude wood appliances in the new units.

RESIDENTIAL BUILDINGS - PRIVATE HOUSING

Fuel oil consumption in private housing is primarily attributed to the approximatly ten units heated solely with oil. Assuming an average private dwelling consumption of 3200 litres/year (at the conservative end of the public housing consumption range), the total private housing use of fuel oil was approximated to be 30,000 litres/year.

Wood fuel consumption in private dwellings was estimated from conversations with home owners, and extrapolated based upon the total private dwelling stock.

3.3 FUEL CONSUMPTION PROJECTIONS

The fuel data presented does not account for all users in the community, and is not expected to remain constant over time. Adjustments and projections to develop a complete picture of community heating fuel oil use over the next few years (in the absence of wood conversion) are presented in this section. These projections are summarized in Table 3.3/1, and are made in the absence of the potential benefits of enhanced energy conservation techniques.

a) COMMERCIAL

The survey of commercial buildings we believe identified all commercial buildings in the community, and accounted for 86,528 litres of fuel oil consumption (Table 3.2/1) from the majority. Incorporating rough estimates for the fuel consumption in buildings when no data was available, suggests that the present total fuel oil consumption in the Rae Edzo community is approximately 105,000 litres. No firm future commercial development plans were identified during community consultations. For the purposes of projection, it is arbitrarily assumed that the commercial sector will grow at the same rate as the residential sector (6.4%/5 years). In actual practice, however, the growth would be in quantum stages as opposed to a smooth rate.

b) MUNICIPAL AND INSTITUTIONAL BUILDINGS

The current stock of municipal and institutional fuel oil consumers is listed in Table 3.2/2. Total fuel oil consumption from these sources is estimated to be 465,300 litres. Future energy consumers in this sector include the planned new structures identified in Section 2.3. The total fuel oil consumptions for the Rae Recreation Complex, Old Folks Home, and Elementary School are roughly estimated to be 140,000 litres. Since this is largely institutional growth, a growth in municipal facilities of 6.4%/5 years is also applied. The resulting projections are as shown in Table 3.3/1.

Table 3.3/1 PROJECTED FUEL CONSUMPTION

RAE-EDZO COMMUNITY *

Sector	Fuel Oil Consumption Accounted For	Estimated Actual Present Total Fuel Oil Consumption	Estimated Total Fuel Oil Consumption	
	Present		1993	2003
FUEL OIL				
Commercial	86,528 Litres	105,000 Litres	119,000 Litres	135,000 Litres
Municipal and Institutional	465,300	465,300	622,000	641,000
Residential	--	550,000	630,000	695,000
WOOD				
Residential	--	1250 cords	1100 cords	1100 cords
Commercial	--	--	--	--
Municipal and Institutional	--	--	--	--

* in the absence of wood conversion initiatives

c) PUBLIC AND PRIVATE RESIDENTIAL DWELLINGS

i) Fuel Oil Consumption

The future housing stock projected for the community is presented in Table 2.3/1 for the next twenty years. The present fuel oil consumption levels of current housing stock are presented in Table 3.2/3.

For the purposes of these projections, the fuel oil consumption per public housing dwelling is assumed to remain constant (3500 litres/ year) for the next 5 years, and to drop to 90% of former levels after that to account for the transition to the user-pay fuel costs policy for public housing.

The current percentage of private homes on fuel oil (10%) is assumed to remain constant over time, with the majority of space heating provided by wood fuel, along present trends. The present ratio of 1.76 public houses to one private home in the community is assumed to drop uniformly to 1.5:1 over the next twenty years to account for the increased desire for private home ownership.

ii) Wood Fuel Consumption

The present rate of use of wood fuel by private households is estimated to be 14 - 15 cords per household per year. It is expected that much more efficient air tight stoves will replace all current wood fired appliances in the next 10 - 15 years. Also, old private homes will be demolished in favour of new, modern, energy conserving structures over the period. Using the same assumptions for private housing stock growth as noted for the fuel oil projections earlier in this section, and assuming a gradual reduction in wood fuel demand to 8 - 9 cords per annum per household (due to better homes and stoves), calculations suggest that NO increase in private residential wood fuel consumption will occur in the Rae Edzo community in the next 20 years.

The wood fuel demand by public housing residential tenants is squarely dependent on the possible implementation of heating fuel user-pay policies by the Housing Association. The projected effect of the policy on fuel oil demand was worked into the Table 3.2/3 residential fuel oil projections but without consideration for any substitution of wood fuel for fuel oil. Obviously, some swing to wood fuel use in public housing would be precipitated by this user-pay policy. A proportionate reduction in public housing fuel oil consumption would occur.

With present plans in public housing, all housing will use oil for heating by the end of 1985.

3.4 ENERGY CONSERVATION EFFECTS

The present and future fuel oil consumption in the community can be reduced by more careful attention to energy conservation principles, without considering a switch to wood fuel. The projections made in the previous section already account for certain measures likely to take place.

The advent of a user pay policy for energy use in public housing will induce tenants to reduce room temperatures, set back temperatures at night, keep doors and windows closed on cold days, etc., all resulting in reduced fuel oil consumption.

The normal process of retirement or rehabilitation of housing in the community will result in increased building insulation levels and a higher general level of building thermal efficiency over time.

Energy conservation practices at the Jimmy Bruneau School will continue to reduce fuel consumption in future years.

Present wood fuel consumption rates were projected to benefit by the gradual replacement of existing appliances with new efficient air tight stoves and burners.

The costs and fuel savings possible from the implementation of various forms of building structural or operating conservation measures were not systematically examined. Such a task was well beyond the scope of this study.

4.0 WOOD BURNING APPLIANCES

4.1 GENERAL

Many different types of wood fired heating units are required to effectively convert a major portion of the community to wood heating. The characteristics, features, performance and availability of current technology wood burning units of various types are outlined in this section. These descriptions serve to illustrate the types of wood burning equipment upon which the community conversion program is based.

For the benefit of Rae Edzo community residents, a separate catalogue of specific product literature and installation notes has been assembled. The catalogue is intended to provide examples of typical units and the features of current equipment for reference purposes, and to more effectively fix in mind the wood burning technologies prescribed in the conversion program. This catalogue was not intended as a deliverable as part of this final report.

Wood burning appliances are inspected and certified by a number of testing agencies in Canada. For assurance of a safely constructed solid fuel heating appliance, the name plate should bear one of the following symbols,

indicating the design has been certified by one of the independent testing organizations

- Canadian Standards Association (CSA)
- Underwriters Laboratories Of Canada (ULC)
- Warnock Hersey Professional Services Ltd. (WHI)

Relevant standards for wood burning equipment are:

a) ULC S627-1979 covering wood burning spaceheaters

b) CSA B366-IM1981 "Solid Fuel Fired Appliances for Residential Use"

c) CSA B366-ZM1981 "Space Heaters for Use with Solid Fuels"

d) CAN 4-5604-78 National Standard of Canada standard for prefabricated Type A chimneys

e) ULC S610 Underwriters Labs standard for factory built fireplaces

f) National Building Code

A recent listing of wood burning appliances that bear the CSA certification is presented on the following pages. Other good quality stoves that may have ULC and WHI certification do not appear on this list.

A variety of wood appliances manufacturers were written requesting operating efficiency test results and documentation on performance certification. Product literature and installation notes were often supplied, but general efficiency test results were supplied only in a single instance.

The installation requirements for wood furnaces differ from oil fired furnaces. Clearances around the appliance, return air duct arrangements, and supply plenum clearances are different. A good installation reference for all types of wood appliances is the CMHC book "Heating with Wood - Safely" (ref. 16) and is enclosed in the product catalogue.
and supply plenum clearances are different. A good installation, and operations and maintenance reference for all types of wood appliances is the CMHC book "Heating with Wood - Safely" (ref. 16) and is enclosed in the product catalogue.

Canadian Standards Association

178 Rexdale Blvd., Rexdale (Toronto), Ontario, Canada M9W 1R3 Telex 06-989344

SPECIAL BULLETIN

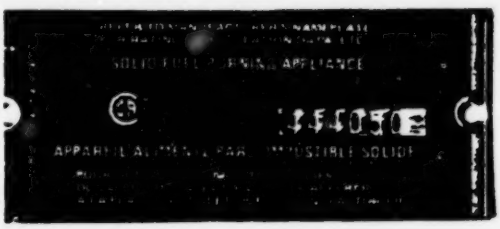
List of CSA Certified Solid Fuel Burning Appliances

As of November 16, 1983

Save your old list because Appliances deleted from this list may still be for sale from inventory.

CSA maintains a certification program for solid-fuel burning appliances based or compliance with the construction and test requirements of CSA Standards B366.1M1981 "Solid Fuel Fired Appliances for Residential Use" and B366.2-M1981 "Space Heaters for Use with Solid Fuels".

Attached is a list of the solid-fuel burning boilers, furnaces and room heaters certified by CSA as of the above date. To be recognized as CSA certified, each appliance must bear the CSA Label illustrated below:



Label Stock No. 8-2431-663

Colour: Black on aluminum

Material: Aluminum plate

Size: 3 in. by 1-1/4 in.

Unless otherwise specified in the listings, these appliances are intended for use in dry and non-hazardous locations. They are intended for connection to a masonry chimney or an approved factory-built chimney.

The data on the nameplate includes the installation clearances, the identity of any special components required, guidance on the recommended maximum firing rate, and other data regarding installation and use.

Heaters intended for mobile home use are shown in the listings as "outdoor-aired" as they may also be used in other housing provided they are installed as recommended.

Unless otherwise specified in the listings, both the electric and wood portion of wood/electric combination furnaces must be installed at the same time.

BOILERS (Class 6515)

A.P.E. ENTERPRISES, File 46816
676 Third Line East, Sault Ste. Marie
Ont., L6A 5K7
Electric and Wood-fired Boilers, Model APE 5000

LES ATELIERS BEAUCHEMIN INC., File 50741
155 rue Carmel, C.P. 660,
Carvville, Que., J0A 1A0
Wood fired hot water boiler, Model S.I.M.-30
Also as Add-on
Tradename: "Beauchemin".

BENJAMIN PRODUCTS LTD., (w.P. , File 41150
P.O. Box 2079, Springhill, N.S., B0M 1X0.
Wood-fired Models "Dutchover" and "Dutchover II"
Also as add-on.
Wood/Oil Hot Water Boiler, Model CC500 with oil burner Model FAFC-2
Input 0.85 - 1.00 gph (US

CORRIGAN'S WOOD STOVE CENTRE, File 48098
Grant St., East Royalty, P.E.I.
Wood-fired Model "Patlyn II". Also as add-on.

ENHEAT LTD., Fawcett Div., File 11187
100E Main St., Sackville, N.B., E0A 3C0
Wood-fired Models: WB140, WB140-D. Also as add-on.
Tradenames: "Fawcett" "Enheat"

FLEETLINE PRODUCTS LTD., File 36661
49 Craig St., Brantford, Ont., N3T 5S7
Wood/anthracite coal-fired - Model MF11C 155.
Also as add-on.

J.W. ROBERTSON LTD., File 51556
685 Victoria Rd., Sydney, N.S., B1N 1L3
Wood/Anthracite Coal Hot water Boiler Models
Logana 02.40-14
" 02.40-19
" 02.40-27
" 02.40-35
" 02.40-40
Tradename: "BOILERS"

LES INDUSTRIES F.P. INC., File 29380
20 Windsor Rd., P.O. Box 160,
Bromptonville, Que., J0B 1H0
Electric/Wood and Anthracite Coal Models:
EW-120-40, EW-120-30, EW-120-25, EW-120-20,
EW-120-15, EW-80-25, EW-80-20, EW-80-15,
WE-30, WE-25, WE-20, WE-18, WE-15, WE-10,
WE-9, WE-8
Wood Burning Model: BHN-W2. Also as add-on.
Wood and Anthracite Coal Model: W2.5, W2-120,
W2-80, W3-200; Also as Add-on.

LA FARGUE MFG. (1982) Ltd., File 51351
RR #5, Site 7, Box 6, Sydney, N.S.,
B1P 6G7
Wood/Anthracite coal Models 50CFL, 75WEL
Tradename: "La Fargue".

FRECO LTD., File 21936
1406, 18 Avenue Ouest, Cherry, Que.,
G6W 3J2
Wood burning and Oil-fired Models: CC-18, CC-20.
Wood Burning Models: B20, WB20. Model WB20
also certified as an Add-on.
Combination Wood and Electric Models: ERB-30,
ERE-25 and EPB-20 (30, 25 and 20kW)

JEFFREY MFG. INC., File 47339
228 South McKellar St.,
Thunder Bay, Ont., P7E 1H7
Wood-fired Model SFB-3. Also as an add-on.

KERR CONTROLS LTD., File 49619
P.O. Box 1800,
Truro, N.S., B2N 5V2
Wood Burning Model: "Jetstream" 100 SE

NEW YORKER BOILER CO. LTD., File 31199
Industrial Park, P.O. Box 1850,
Sussex, N.B., E0E 1P0
Boiler Models WF100 and WF200. Also as add-on.

PARRSBORO METAL FABRICATORS LTD., File 41889
P.O. Box 637, Crossroads,
Parrsboro, N.S., B0M 1S0
Wood-fired Model Titan T101. Also as an add-on.

POWERMATIC OF CANADA LTD., File 47804
CP 3572, 709 Leveille,
Terrebonne, Que., J6W 1Z9
Wood/Anthracite Coal-fired Model MW-100.
Also as add-on
Wood-fired Model MW-90 (Also Add-on)

RENALD MORIN & FILS INC. File 31611
Rue St. Jallier, St. Eleuthere,
Pomerleauville, Cte Kamouraska,
Que.
Wood-fired Models: B-24 and B-36.

ADD-ON BOILERS

This list is for convenient reference. It duplicates listings of add-on boilers in the "Boiler" Section.

Please note that boilers certified for add-on installation must bear the marking on the boiler "May be connected to an existing boiler system" and "Tested September 1981 to CSA B366.1-81".

CERTIFICATION IS NOT RETROACTIVE

LES ATELIERS BEAUCHEMIN INC., File 50741
155 rue Carmel, C.P. 660,
Darville, Que., J0A 1A0
Wood fired hot water boiler, Model S.I.M.-30
Also as Add-on
Tradename: "Beauchemin".

BENJAMIN PRODUCTS LTD., (w.P., File 41150
P.O. Box 2079, Springhill, N.S., B0M 1X0
Wood-fired Models "Dutchover" and "Dutchover II". Also as add-on.

CORRIGAN'S WOOD STOVE CENTRE, File 48098
Grant St., East Royalty, P.E.I.
Wood-fired Model "Patlyn II".
Also as add-on.

ENHEAT LTD., File 11187
Fawcett Div., 100E Main St.
Sackville, N.B., E0A 3C0
Wood-fired Models: WB140, WB140-D. Also as add-on.
Tradenames: "Fawcett" "Enheat"

F.P. INDUSTRIES INC., File 29380
20 Windsor Rd., Bromptonville, Que.
J0B 1H0
Wood-fired Model BHN-W2
Wood and Anthracite Model W2.5, W2-120,
W2-80, W3-200.

FLEETLINE PRODUCTS LTD., File 36661
49 Craig St., Brantford, Ont.
N3T 5S7
Wood/Anthracite Coal-fired Model MF11C/155.
Also as add-on.

FRECO LTD. File 21936
1408, 13 Avenue Ouest,
Charny, Que., G6W 3Z2
Wood Burning Models: B2C, NB2C. Model NB2C
also certified as an Add-on.

JEFFREY MFG. INC., File 47399
228 South McKellar St.
Thunder Bay, Ont., P7E 1H7
Wood-fired Model SFB-3. As an add-on.

NEW YORKER BOILER CO. LTD., File 31285
Industrial Park, P.O. Box 1850
Sussex, N.B., E0E 1P0
Wood-fired Models WF1CC, WF20C.
Also as add-on.

PARRSBORO METAL FABRICATORS LTD., File 42569
P.O. Box 637
Cross Roads, Parrsboro, N.S., B0M 1S0
Wood-fired Model Titan T101. As an add-on.

POWERMATIC OF CANADA LTD., File 47624
709 Leveille, Terrebonne, Que.
J6W 1Z9
Wood/Anthracite Coal-fired Model MW-10D,
MW-9C.

FURNACES (Class 6516)

BENJAMIN PRODUCTS LTD. (W.R.), File 41152
P.O. Box 2079, Springhill, N.S., B0M 1X0,
Wood and Oil Burning Model: CF-144 with
oil-burner: FAFC-2-5.5,
Nozzles: 0.85, 1.0 gph(US)
Wood Burning Model WK400
Tradename: "Benjamin"

BONNECHERE METAL PRODUCTS LTD., File 48429
R.R. 2 Sand Rd., Eganville, Ont., K0J 1T0,
Wood Burning Model: "Celsius III"
Wood and Electric Model: "Celsius III-WE"
(10, 15, 20Kw)
Tradename: "Celsius"

DUO-MATIC OLSEN INC., File 17387
Olsen Div., Louise St. & Hwy 2
Tilbury, Ont., N0P 2L0
Wood Burning Model: DWF20
Wood and Coal Burning Model: CWF
Wood and Oil Burning Models:

Model	With Oil Burner	Gph (US)
BBC-95	FAFC-3 or AF90YB	0.85
BBC-112	FAFC-3 or AF90YB	1.00
BBC-124	FAFC-3 or AF90YB	1.10
BBC-136	FAFC-3 or AF90YB	1.20
DWO-1.00/113	FAFC-3	1.00
DWO-1.00/114	SR55RF	1.00
DWO-1.20/133	FAFC-4	1.20-1.25
DWO-1.20/137	SR55RH	1.10-1.20
DWO-1.35/152	FAFC-4	1.35
DWO-1.35/148	SR55RN	1.35

Wood, Coal and Oil Models:

Model	With Oil Burner	Gph (US)
CWO-A-110	FAFC-3-9-A	1.00-1.10
CWO-A-139	FAFC-3-9-A	1.20-1.35
CWO-B-112	SR90-RF	1.00-1.10
CWO-B-140	SR90-RF	1.20-1.35
CWO-B-168	SR90-RF	1.50

Wood and Electric Models: CWF-E-15, CWF-E-20,
CWF-E-25
Tradenames: "Duomatic/Olsen", "Zenith",
"Cambrian".

ENERGY TUBE LTD., File 48927
18 Ypres Street, Edmundston, N.B., E3V 3G7
Wood Burning Model: H-30
Tradename: "Energy Tube".

ENHEAT LTD., File 11187
100 E. Main St., Sackville, N.B.
E0A 3C0
Wood Burning Models: WF-200, CWF-85, WF-90
Wood, Anthracite and 1" Bituminous coal
burning Model: CWF-85H
Wood and Oil Models:

Model	With Oil Burner	Gph (US)
WO-113/115	WO113/155	1.00, 1.10, 1.25, 1.35

Tradenames: "Fawcett", "Enheat".

ENTERPRISE FOUNDRY CO. LTD., File 10769
Lorne St., Sackville, N.B.
Wood Burning Models: 81308-1
Tradenames: "Enterprise".

HUNTER ENTERPRISES ORILLIA LTD., File 39361
P.O. Box 400, 1 Colborne St.
Orillia, Ont., L3V 6H1
Wood Burning Models: HW-80, HW-80L, HW-100
Wood and Oil Burning Models:

Model	With Oil Burner	Gph (US)
HWO-100	FAFC-3	1.00
HWO-125	FAFC-3	1.25
HWO-135	FAFC-3	1.35
HWO-150	FAFC-3	1.50

Wood and Electric Model: HWE-80 (15, 20, 25Kw)
Tradenames: "Hunter", "Valley Comfort".

ICG MANUFACTURING LTD., File 12049
Div. of Inter-City Gas Corp.,
340 Welland Ave., St. Catharines,
Ont., L2R 7B8
Wood and Electric Model: EWA (10, 15, 20, 25Kw)
Tradenames: "ICG", "FURNASMAN", "MacLeods".

KIRK'S SHEET METAL PRODUCTS, File 37122
P.O. Box 222, Three Hills, Alta.,
T0M 2A0
Coal Burning Models: 108, 178 stoker-
equipped
Tradename: "Kirk's"

NEWMAC MFG. Inc., File 42818
236 Norwich Ave.
Woodstock, Ont., N4S 7Y5
FACTORY: Air Industrial Park, Lancaster Cres.,
Debert, N.S., B0M 1G0
Wood and Oil Burning Models:

Model	With Oil Burner	Gph (US)
CL85	FAFC-2-7	0.75
CL-86C	FAFC-2-8	0.75
	SR81RD	0.75
CL-86G	FAFC-2-8	0.75
	SR81RD	0.75
CL-95	FAFC-2-7	0.85
CL-96C	FAFC-2-8	0.85
	SR81RD	0.85
CL-96G	FAFC-2-8	0.75
	SR81RD	0.85
CL-114	FAFC-2-7	1.00
CL-115B	FAFC-3-8	1.00
	SR81RF	1.00
CL-115G	FAFC-3-8	1.00
	SR81RF	1.00
CL-140B	FAFC-3-8	1.25
CL-140C	FAFC-3-8	1.25
	SR81RD	1.25
CL-140G	FAFC-3-8	1.25
	SR81RF	1.25

CL-155B.....	FAFC-4-8.....	1.35
CL-155C.....	FAFC-3-8.....	1.35
	SR81RF.....	1.35
CL-155G.....	FAFC-3-8.....	1.35
	SR81RF.....	1.35
CL-170B.....	FAFC-4-8.....	1.50
CL-170C.....	FAFC-3-8.....	1.50
	SR81RF.....	1.50
CL-170G.....	FAFC-3-8.....	1.50
	SR81RF.....	1.50

Above models with Suffix G also burn anthracite coal.
Wood Burning Models: WG-100, WB-100, WS-100
Wood/Electric Furnace Models: WB-100E, WG-100E (10 to 25 kw)
Tradename: "Newmac"

NEWMAC MFG. INC., File 35947
136 Norwich Ave., Woodstock, Ont., N4S 7Y5
Wood/Electric Furnace Models WB-100E, WG-100E (10 to 25 kw)
Wood and Coal Models WG-100, WB-100.
In-line Wood and Oil-fired Combination Furnaces
Models below with Suffix G also burn anthracite coal.

Model	Oil Burner Model	Nozzle gph (US)
CL-86C.....	FAFC-2-8.....	0.75
	SR81RD.....	0.75
CL-86G.....	FAFC-2-8.....	0.75
	SR81RD.....	0.75
CL-96C.....	FAFC-2-8.....	0.85
CL-96G.....	FAFC-2-8.....	0.85
	SR81RD.....	0.25
CL-115B.....	FAFC-3-8.....	1.00
	SR81RF.....	1.00
CL-115G.....	FAFC-3-8.....	1.00
	SR81RF.....	1.00
CL-140C.....	FAFC-3-8.....	1.25
	SR81RF.....	1.25
CL-140G.....	FAFC-3-8.....	1.25
	SR81RF.....	1.25
CL-155C.....	FAFC-3-8.....	1.35
	SR81RF.....	1.35
CL-155G.....	FAFC-3-8.....	1.35
	SR81RF.....	1.35
CL-170C.....	FAFC-3-8.....	1.50
	SR81RF.....	1.50
CL-170G.....	FAFC-3-8.....	1.50
	SR81RF.....	1.50

PARRSBORO METAL FABRICATORS LTD., File 42589
P.O. Box 637,
Cross Roads, Parrsboro, N.S., B0M 1S0
Wood Burning Model: DB101, DB102
Tradename: "Kerr Scotsman".

POWRMATIC DU CANADA LTEE., File 50477
709 Leveille, Terrebonne, Que. , J6W 1Z9
Wood Burning Model: W-80.
Wood/Electric Models: EW-20, EW-18, EW-15, EW-10, (20, 18, 15, 10kW)
Tradename: "POWRMATIC".

PROCAM STEEL PRODUCTS LTD., File 41006
Westmeath Industrial Park,
Hwy. 17 East, Pembroke, Ont., K8A 6W3
Wood Burning Models: 1018, 1018-C.
Wood Burning and Electric Model: 1018E
Wood and Oil Burning Model:

Model	With Oil Burner	Gph (US)
1018O	FAFC-2 or AF72XN	85-1.00

Tradename: "Surefire".

R.S.F. ENERGY LTD., File 4[illegible]
P.O. Box 3637, Smithers, B.C., V0J 2N0
Wood Burning Model: F75W
Wood Burning and Electric Model: F10C-WE (10, 15, 20kW), F75-WE (10, 15, 20kW)
The electric furnace part of this combination may be installed at a later time.
Tradename: "RSF Energy"

SHELLWOOD INDUSTRIES LTD., File 4[illegible]
P.O. Box 69, Postal Station Transcona, Winnipeg, Man., R2C 2Z8
Wood-fired Model: SEGL-24.
Tradename: "FRUGAL FIRE".

SHERBROOKE MFG. CO. LTD., File 19[illegible]
475 Granville St., Summerside, P.E.I. C1N 4P7
Wood Burning Model: W-200

SOCIETY METROHEAT INC., File 154[illegible]
4609 Iberville St., Montreal, Que. H2H 1L9
Wood Furnace Models: MW-200
Solid Fuel and Oil Burning Models:

Model	with Oil Burner	Gph (US)
OWC-[illegible].....	A1-Cm-1.....	[illegible]
OWC-114.....	A1-Cm-1.....	1.00
OWC-134.....	A1-Cm-1.....	1.10
OWC-157.....	A1-Cm-1.....	1.25
OWC-176.....	A1-Cm-2.....	1.50

TREMT METALS LTD., File 4[illegible]
844 Rye St., P.O. Box 1088,
Peterborough, Ont., K9J 7H4
Wood Burning Models: S120-D, S110-F.
Wood and Coal Burning Model: S110G.
Solid Fuel-electric Models: SE120F, SE110G, SE110G (15, 20, 25 kW)
Tradenames: "Summeraire", "Trent".

ADD-ON FURNACES

These furnaces can only be connected as add-on series with and to the outlet of existing [illegible] or low-boy oil furnaces having a rated [illegible] input rating as shown.

The directions for minimum duct sizes, duct clearances, attachment to divided plenums of oil furnaces and the manufacturer's instructions must be followed.
The change of circulating air blower and relocation of any safety controls is prohibited.

The connection to a divided plenum on an oil furnace is prohibited unless so certified.

Each furnace shows the month and year of certification.

CERTIFICATION IS NOT RETROACTIVE - IT DOES NOT INCLUDE FURNACES SHIPPED OR INSTALLED BEFORE THE ABOVE DATE.

W. R. BENJAMIN PRODUCTS LTD., File 4116[illegible]
Junction Rd., Springhill, N.S., B0M 1G0
Wood-fired Add-on Model WK40DA
For not-divided oil furnace plenum with inputs 0.85 to 1.10 gph (US)

BROCK ENGINEERING MFG. CO. LTD.,
4305 Iberville, Montreal, Que., H2H 2L5
Wood fired add on Model 3624
For non-divided oil furnace plenum with input of 1.00 gph (US) only.

DUOMATIC/OLSEN INC., File 17327
Olsen Div., Louis St. & H'Way 2,
Tilbury, Ont., N0P 2L0
Wood and anthracite coal fired Add-on Models CWF-A (non-divided plenum) & CWF-B (divided plenum)
For add-on to oil furnace with following inputs CWF-A 0.65 to 1.20 gph (US) and CWF-B 0.75 to 1.00 gph (US).

ENHEAT INC., Fawcett Div., File 11187
100 E. Main St., Sackville, N.B.,
E0A 3C0
Wood-fired Add-on Model WF200-A
For non-divided plenum add-on to oil furnace with inputs 1.00 to 1.35 gph (US).
Wood-fired Add-on Model WF-90A
For non-divided plenum add-on to oil furnace with inputs 0.65 to 1.10 gph (US)

ENTERPRISE FOUNDRY CO. LTD., File 10769
Lorne St., Sackville, N.B., E0A 3C0
Wood-fired Add-on Model 6130E-1A
For non-divided plenum add-on to oil furnace with inputs 0.85 to 1.50 gph (US)

HUNTER ENTERPRISES, ORILLIA LTD., File 39361
P.O. Box 400, 1 Colborne St.,
Orillia, Ont., L3V 6K1
Wood-fired Add-on Model MP80
For non-divided plenum add-on to oil furnace with inputs .080 to 1.20 gph (US).

MALLEABLE IRON RANGE CO., File 48568
715 N. Spring St., Beaver Dam, WI 53916
Wood-fired Add-on Model AF524S-CSA, AF324S-CSA.
For non-divided or divided plenum add-on to oil furnace with inputs 0.50 to 0.85 gph (US).
Tradename: "MONARCH".

NEWMAC MFG. INC., File 42818
236 Norwich Ave., Woodstock, Ont., N4S 7Y5
FACTORY: Lancaster Cr. Debert, N.S., B0M 1G0
Wood/Anthracite Coal-Fired Model WGA100
For Add-on to an oil furnace with following inputs:
Non-divided plenum connection: 0.75 to 1.00 gph (US).
Divided plenum connection: 0.75 gph (US) only.

PARRSBORO METAL FABRICATORS LTD., File 42569
P.O. Box 637, Cross Rd.
Parrsboro, N.S., B0M 1S0
Wood-fired Add-on Model Scotsman DB-101-ADD
For non-divided plenum add-on to oil furnace with inputs 0.85 to 1.50 gph (US).
Wood fired add-on Model DB-202A, for divided or non-divided plenum add on to an oil furnace with inputs 0.75 to 0.90 gph (US).

PROCAM STEEL PRODUCTS LTD., File 41006
Westmeath Ind. Park H'Way 17E.
Pembroke, Ont., K8A 6W3
Wood-fired Add-on Model 201A, 301A
For non-divided plenum add-on to oil furnace with inputs 0.85 to 1.25 gph (US).

R.S.F. ENERGY, File 46455
2965 Tatlow Rd., P.O. Box 3637
Smithers, B.C., V0J 2N0
Wood-fired Add-on Model F75WA
For non-divided plenum add-on to oil-fired furnace with input of 0.85 gph (US) only.

SHERBROOKE MFG. CO. LTD., File 39172
475 Granville St., Summerside, P.E.I.
Wood-fired add on Model WOODADD for non-divided add-on to an oil furnace with input of 0.85 to 1.25 gph (US).

SOCIETE METROHEAT INC., File 15439
4609 Iberville
Montreal, P.Q., H2H 1L9
Wood-fired Add-on Model MW300
For non-divided plenum add-on to an oil furnace with input of 1.10 gph (US) only.

TREAT METALS LTD., File 42867
844 Rye St., P.O. Box 1088
Peterborough, Ont., K9J 7H4
Wood-fired Add-on Model S-150
For non-divided or divided plenum add-on to an oil furnace with input of 0.75 gph (US) only.

TUBULAR GRATES (Class 6517)

The following have been certified to CSA Fuel Burning Notice 49 for use in an existing masonry fireplace.

LES FOYERS TREL INC., File 49022
2969 Bergman, Parc Industrial,
Chomedey, Que., H7L 3Y5
Wood Burning Model 81
Tradename: "TREL".

SHEPHERD MFG. CO. LTD., File 51164
37 Esna Park Dr., Markham, Ont., L3R 1C9
Wood burning Models: 3250-1, 3250-2, 3227-1, 3227-2.

UNIQUE FUNCTIONAL PRODUCTS, File 38992
135 Sunshine Lane, San Marcos, CA 92069
Models: 23, 26, 28, 21.
Model: 90H71-1C.

SPACE HEATERS (Class 6532)

ALTERNATIVE STOVE CO., LTD., File 47193
24 Melham Court, Units 2 and 4
Scarborough, Ont.
Wood Burning Model: "Alternative I"

ARMORAL INC., File 47707
5850 Trudeau
St-Hyacinthe, Que., J2S 1H4
Wood Burning Models: "Wood Save", "Marksman I", "Marksman II", "Armo"

ATLANTA STOVE WORKS INC., File 47367
P.O. Box 5254, Krog St.,
Lake Ave. & Southern R.R.,
Atlanta, GA 30307
FACTORY: Duomatic/Olsen Inc., Tilbury, Ont.
Wood Burning Model: 240/124C
Tradenames: "Atlanta", "Homesteader", "Knight".

BENJAMIN PRODUCTS, File 41152
P.O. Box 279, Springhill, N.S., B0M 1X0
Wood Burning Model FK-1C0.
Tradename: "FIREKING", "BENJAMIN".

B and B ENTERPRISES. File 48533
R.R. #1, Ashburn, Ont., L0B 1A0
Wood Burning Models: Rivale, Ovatum.
Tradename: "Trillium".

CITY METAL FABRICATION LTD., File 49366
565 Canarctic Drive,
Downsview, Ont., M3J 2P9
Wood Burning Model: 820

CEMI PRODUCTS, File 43334
DIV. OF ARBEN DISTRIBUTORS LTD.,
70 Covington St., P.O. Box 3560, Station C.
Hamilton, Ont., L8H 7M9
Wood Burning Models: HMF-1, HMF-2, HMF-1V, HMF-2V.
Tradename: "Independence".

COHEN & PECK INC., File 48373
14 Arrow St., Cambridge, MA 02138
Wood Burning Model "Amity"
Tradename: "Flame:".

DUTCHWEST INDIA GROUP, File 45903
990 Industry Dr., P.O. Box 88094
Seattle, WA 98188
FACTORY: Taipei, Taiwan.
Wood Burning Models: FA224L, FA266L.
Tradename "Federal Airtight"

EBI INDUSTRIES INC., File 47015
37 Raglin Place, Cambridge, Ont., N1R 7L2
Wood Burning Models: Baby Bear, Mama Bear, Papa Bear, Grandma Bear, Grandpa Bear, Fireplace Insert.
Tradename: "Fisher"

EBCO BUSINESS INDUSTRIES INC., File 46939
7170 Antrim Ave., Burnaby, B.C, V5J 4M9
"Fisher" wood Burning Model "Fireplace Insert".

ECONOWOOD HEATING LTD., File 43894
P.O. Box 62, R.R. No. 2, Airport Rd.
Kenora, Ont. P9N 3X1
Wood Burning Models: EC18E, EC24E, EC30E.
Tradename: "Econowood".

EFEL NORTH AMERICA INC., File 49782
4 Cummings Park, Woburn, MA 01801
Tradename "Efel"
Wood Burning Models Kamina "T" 080.66, Kamina Wood 079.66, Kaminette Wood 079.63

ENERGSAVE SYSTEMS LTD., File 44966
P.O. Box 187, Pesticouche Rd.,
Oromocto, N.B. E2V 2G3
"Lakewood" Wood Fired Models: Cottager, Unicorn, Elk, Squire and "Unicorn Fireplace Insert" CI-1

ENERGY/HEAT SAVING PRODUCTS, File 45735
Div. of 345320 Ontario, 428 Brock Ave.,
Toronto, M6H 3N3
FACTORY: John G. Wilson Machine Ltd.,
Catncart, Ont.
"Provincial" Wood Fired Models: Family Traditional 1, 1-G; Family Classic 2, 2-G; Den Circulator 3, Parlor Circulator 4, Pyramic Style 5, Space Heater/Insert 6, 6-G.
Tradename: "Provincial".

ENHEAT LTD., File 11187
Sackville, N.B. E0A 3C0
Wood or Coal Burning Model: CW66
Tradenames: "Fawcett", "Enheat", "Atlantic"

ENTERPRISE FOUNDRY CO. LTD., File 21[illegible]
Lorne St., Sackville, N.B. E0A 3C0
FACTORY: Sackville, N.B.
Wood Burning Models: 24AT, 90NH, 90NHC, 90AT, 90ATC
Wood Burning cookstove Model "Savoy 53".
"Savoy 53C", "Savoy Extended 53T" and "Savoy Extended 53CT".
Tradename: "Enterprise", "Night Owl", "Night Hawk"

GERMAIN SAVIGNAC, File 51142
26 rue. Archambault,
St. Jean de Matha, Que. J0K 2S0
Wood Burning Models Chateau & Bangalow
Tradename: "deux dans un".

GSW BUILDING PRODUCTS DIV. File 49366[illegible]
P.O. Box 526, Stn. B,
Hamilton, Ont. L8L 7X6
Wood Burning Model: J1G07
Tradename: "GSW".

LES POELES ST. GEORGES INC., File 49631
798, 3e Ave. Est., Beauce Sud,
La Guadeloupe, Que. G0M 1G0
Wood Fired Models: 1800, 1810, 1880, 1900, 191[illegible]
Tradename: "Colonial", "Baron", "Faysan".

GEORGE A. HARDING, LTD., File 47833
61 Telson Road, Markham, Ont. L3R 1E4
Wood Burning Models: HF 45, HF 65.
Wood Burning outdoor aired Models HF-45M, HF-65M
Tradename: "RSF" Energy

LES PRODUITS G.M.P. ENRG., File 49631
1244 Avenue Ferland, Normandin, Que. G0W 2E0
Wood Burning Model Braisier 2 Portes, 1 Porte
Tradename: "Braisier".

GOTT ENTERPRISES LTD., File 46194
No. 15 2170 Dollarton Hwy.
North Vancouver, B.C. V7H 1A7
Wood Burning Models: Baby Bear*, Mama Bear*, Papa Bear*, Granama Bear*, Grandpa Bear*, Teddy Bear, Fireplace Insert.
*Model designation may be followed by "(I-CS)" to indicate an alternate construction.
Tradename: "Fisher".

GULLICKSON'S FISHER STOVE WORKS INC., File 49[illegible]
213 Pine St., P.O. Box 448,
Grantsburg, WI 54840
Wood Burning Models: Grandpa, Grandma, Mama, Papa, Baby, Teddy Bear
Fireplace Insert
Tradename: "Fisher"

J. HARRISON CONTRACTING PRINCE GEORGE LTD., File 49[illegible]
3062 S. Queensway, Prince George,
B.C. V2L 4M8
Wood Burning Model: 106A
Tradename: "Harrison"

HAUGHS PRODUCTS LTD., File 51[illegible]
25 Rutherford Road South
Brampton, Ont. L6W 3J3
Tradename: "Solarwood"
Wood Burning Models: "Cooke Maxi", "Cooke Mini", "Sunburst Maxi", "Sunburst Mini", "Sunburst Maxi II", "Sunburst Mini II", "Double Door", "Sunburst Large", "Sunburst II" Large
"Cooke" Fireplace Inserts: Wood Burning Only, "Sunrise" C.I. Doors, Wood or Anthracite Coal burning "Sunrise" Glass Door," Sunrise II" Glass Doors.

HERITAGE ENERGY SYSTEMS INC., File 47567
23 Balsam St., Collingwood, Ont. L9Y 4H7
FACTORY: Collingwood, Ont.
Wood Burning Models: 18, 24, 30, M30S, M30SG, M24G, M24S, M24SG, M18S
Trade Name: "Heritage".

HEARTH-FIREPLACE FURNACE MFG. LTD., File 41832
4390 Paletta Court, Burlington, Ont. L7L 4A5
Wood Burning Models: WC 100A, WC100C, WC 200, WC 500A, WC 500, AWH 85, AWH 85B, AWH 80, AH-62, Olympic Crest, Wood and Coal Burning Model WC300.
Wood Burning Fireplace Insert FH2636, FH2636M and Coal Fired Model FS2636 Super.
Tradenames: "Hevac", "Wood Chief", "Insert".

HIGH COUNTRY ENGINEERING, File 46964
P.O. Box 43, R. R. No. 1
Carleton Place, Ont. K7C 3P3
Wood Burning Models: 1618, 1418, 1424, 1414-1, 1418CBA.
Tradename: "Carlock".

HUNTER ENTERPRISE CRILLIA LTD., File 39361
P.O. Box 400, 1 Colborne St.
Orillia, Ont. L3V 6H1
Wood Burning Models: C0161, C0803, C-31, C-26, VC60, VC60S, VC66, VC66S, MH40 Delux, MH65 Delux,
Outdoor-Fired wood Burning Models: MH40, MH65
Tradenames: "Hunter", "Valley Comfort", "Cosy Comfort".

LEON TOURAULT & FILS File 50716M
180 Principale, Granby, Que., J2G 2Y4
Wood Burning Model: Flame 86C, Flame 87, Flame 88, Flame 90.

LES FOYERS TREL File 49022
3675 Aur Des Perrons, Auteuil, Laval, Que. H7L 1K5
Wood Burning Model: JALAP
Tradename: "TREL".

LES POELES IROQUOIS INC. File 42316
615 2e rue. Ste. Helene, Ste. Hagot, Que. J0H 1W0
Wood Burning Model: IROQUOIS I
Tradename: "IROQUOIS".

LES POELES PELLAND INC. File 52697
180 rue Charles Peguy, La Prairie, Que. J5R 4H6
Wood Burning models: 100, 200, 300, 400
Tradename: "Trapper".

LAKEWOOD MFG. CO. LTD., File 41946
1 Lakewood Cres., Bobcaygeon, Ont. K0M 1A0
Wood Burning Models: Cottager, Unicorn, Elk, Squire, Unicorn Fireplace Insert CC-1
Unicorn Catalytic CC-2
Tradename: "Lakewood"

LAMB STOVE FABRICATIONS INC., File 42881
Wallace St., P.O. Box 196
Emerson, Man. R0M 0N0.
Wood Burning Model 2000 (King), 1902 (Queen), 1902 (Prince), 902 (Princess) with prefix T or R.
Tradenames: "Emerson" "Royal Joshua"

LES POELES McCARTHY, File 48740
18 de l'Erable, St. Gabriel, Que. J0K 2N0
Wood Burning Models: 101, 102

MAC-FERR METAL FABRICATORS LTD., File 46876
1990 Ellesmere Ave., Scarborough, Ont. M1H 2W2
"Ellegro" Wood Burning Fireplace Inserts Series 8000.
Models 111E, 111E

MAC FORGE INC., File 46494
7719 - 18E Avenue., St. Michel, Montreal, Que. H2A 2N6
Wood only "MacForge", Models: 01P, 01P 1, 01P1 A1P 1

MILES INDUSTRIES LTD., File 49407
1293 Marine Dr.,
North Vancouver, B.C. V7P 1T3
"Petit Godin" wood or Anthracite Coal
Model's: 3700, 3701

NCR-42 INC. File 50719
800 South St.,
Cowansville, Que. J2K 2Y4
Wood Burning Models: Cottager, Unicorn, Catalytic, Elk, Squire, Unicorn Fireplace Insert
Tradename: "Lakewood".

OLSEN STOVEWORKS LTD., File 48971
P.O. Box 575, 549 Killaly St. East
Port Colborne, Ont., L3V 6X6
Wood Burning Models: WFP-LL & FLS-SL, CMT-ML, Hearth mount stoves Model's FBI-HM, FBL-HM and HW-HM
Tradenames: "Olsen", "Inferno".

PACIFIC ENERGY, File 46602
Div. of E.P. Industries Ltd., P.O. Box 814, Duncan, B.C. V9L 3X9
FACTORY: Cobble Hill, B.C.
Wood Burning Model: 43, 43BV, 43Pac, 43PacBr, 27PacBV, 27PacBvFP
Outdoor Fired wood Burning Models 43 O A, 27 O A
Tradename: "Pacific Energy,"

RSF ENERGY, File 46488
P.O. Box 3637, Smithers, B.C. V0J 2N0.
Wood Burning Models: HF 45, HF 88,
Outdoor-fired wood Fired Models: HF45W, HF88W, HF-50, HF-70,
Tradename: "RSF Energy".

REVERSOMATIC HEATING AND MANUFACTURING LTD., File 46919
Downsview, Ont. 4480 Chesswood Dr.
FACTORY: Concord, Ont.
Wood Burning Models: Reverso-2E, Reverso-4E, Reverse 15-E, Reverso 15F and Reverse 15-15F.
Fireplace Insert Model: Reverso 4...

ROBY METAL LTEE. File 51665
222 St. Joseph St., Route 108,
P.O. Box 180, St. Victor de Beauce, Que. G0M 2B0
Wood Burning Models "Repos", "Roby".
Tradename: "Roby"

SANIGA STOVES LTD. File 50561
P.O. Box 31, Bond Head, Ont. L0G 1B0
Wood Burning Model: Stepstove No. 1000
Tradename: "SANIGA".

SIMPSONS-SEARS LTD., File 41832M3
222 Jarvis St., Toronto, Ont.
Wood Burning Models: 42903, 42910, 42915, 42906, 42950, 42955, 42904, C427-42907, C427-42956 C427-42957.
Wood and Anthracite Coal Model: C427-42908
Wood Fired Fireplace Insert: C427-42100
Wood and Anthracite Fired Fireplace Insert: C427-42101, C427-42105

SPACEMAKER LTD., File 46407
3069 Wolfdale Rd., Mississauga, Ont.
L5C 1V9
Wood Burning Model: Combifire (MI-EP1001-1) Combifire (MI-EP-1001)
Tradename: "Airsmith Stoves".

SUBURBAN MFG. CO., File 42403
P.O. Box 399, Dayton, Tenn. 37321
Wood or Coal Burning Models: C6-P1C, CC3-7BC.
Wood Burning Models: WC3-7BL, W6-61C
Outdoor-Fired Wood Burning Model: MM-7818
Tradename: "Suburban".

TRIPLE "R" METAL FABRICATORS LTD., File 49389
RR. One, Site 1, C-3 Rd., Winnipeg, Man.
Wood Fired Models: 1000, 1500, 1670 and 2000 with Quench Tube R.
Tradename: "Sheffield".

TRI-LANE DISTRIBUTING LTD. File 44802
R. R. #4, Lot 7, Conc. 2,
Tottenham, Ont. L0G 1W0
Wood Burning Models: "Peter Godin" 3700, 3701

LES POINCONS WATERLOO INC., File 46171
C.P. 616, 512 Chemin Grandy,
Waterloo, Que. J0E 2H0
FACTORY: Waterloo, Que.
Wood Burning Models: Campagnar I-LO1TC, [illegible], Vendome Ile Grand Duc, Vendome Ile Grand Duc "C".

WILL STEEL LTD., File 49079
4101 Glenaerup Rd., Victoria, B.C., V8L 3H9
FACTORY: 4-10114 Wolfgang Park Rd., Surrey, B.C.
Wood Burning Models: A1, B1
Tradename: "Will"

WOLF STEEL LTD., File 47688
59 Bell Farm Rd., Unit 3, Barrie, Ont.
L4M 5G1
FACTORY: Barrie, Ont.
Wood Burning Heaters Models: 1000, 1600, 2000, 1200R
Wood Burning Fireplace Insert Model: FI1600
Tradenames: "Timberwolf", "Napoleon".

WOODCRAFT STOVES, File 46660
330 Horner Ave., Etobicoke, Ont. M8W 3Z3
Wood Burning Models: Family Traditional No. 1 and No. 1G, Family Classic No. 2 and No. 2G, Super No. 3 and 3G, Oven No. 5 and No. 5G.
Fireplace Insert Models: Fireplace Insert Sloped Back 700, Fireplace Insert Sloped Back G700
Hearth Stove Model: 600 Heartstove.
Tradenames: "Woodcraft" "Heatcraft"

WOOD-TREND IND. INC. File 47278
Route 4, Box 218, Walla, Walla, WA 99362
Wood Burning Models: KT3020, KR3020, KT3020, KR3020, KT3020, PR2020, PT2020, PR2020, KT3520, KT3520, KR3520, PT2520, PR2520, PT2520, PR 2520
Wood Burning Fireplace Insert Models: KFF4020, PFF4020
Wood Burning Out-Aired Models PM2020, PM2020,
Tradenames: "Energy-King", "Energy Princess", "Jet-Air", "Blaze-King", "Blaze Princess".

Z-AIR FABRICATION INC., File [illegible]
690 Trans Canada Hwy, Lorraine, Que.
J4G 1P2
Tradename: "Z-Air"
Wood Burning Models: Water

FIREPLACE INSERTS

This is a representative model of the fireplace inserts listings under the manufacturers preceding pages.

2500 Burner Industries Inc.
3BI Industries Inc.
Energysave Systems Ltd.
Energy Heat Saving Products, [illegible]
Gullickson & Fisher Stove & Tank Ltd.
Gott Enterprises Ltd.
Heights Products Ltd.
Hexac-Fired Ace Furnace Mfg. Ltd.
Lakewood Mfg. Co. Ltd.
[illegible]
MacKerr Metal Fabricators Ltd.
Reverscraft Heating and [illegible]
Simpsons-Sears
Will Steel Ltd.
Woodcraft Stoves
Woodcutters Mfg. Inc.

Outdoor-Fired or Mobile Home Stove Heater

This is a representative [illegible] listings under [illegible] preceding pages.

Woodcutters Mfg. Inc.
George A. Harding
Hunter Enterprises Seattle Ltd.
Pacific Energy
RSF Energy
Suburban Mfg. Co.

4.2 WOOD STOVES

Wood Stoves are available in a wide variety of designs, shapes and styles.

Radiant heaters are single walled stoves that provide heat to the surroundings by radiation from the stove body. "Pot bellied" stoves are an example of this type of heater.

Circulating stoves are double walled units with an inner combustion chamber, and an outer shell. Air is naturally (or with fan assistance) circulated between the inner and out shell to absorb heat for conveyance into the room. Some units have thermostatically controlled dampers.

Combination stoves are radiant (single wall) units, so called due to the capability to open up the stove to view the fire as a fireplace. The "Franklin" style stove is of this variety.

Maximum operating efficiency (amount of heat energy supplied to the room from a given energy unit of wood fuel) is achieved in a stove with the following characteristics (ref 1):

1) airtight construction so that air can enter only through controlled combustion air inlets (gaskets in the doors)
2) well-fitted combustion air inlets
3) a firebrick liner in the firebox
4) a baffle plate, preferably vertical, to increase combustion gas path length
5) a combustion gas exit close to the coals
6) a heat exchanger area
7) a blower, properly used only when flue gas temperatures are sufficiently high

These characteristics are manifested in the flow pattern of the hot gases within the fire box. Five flow patterns are illustrated in the figure below.

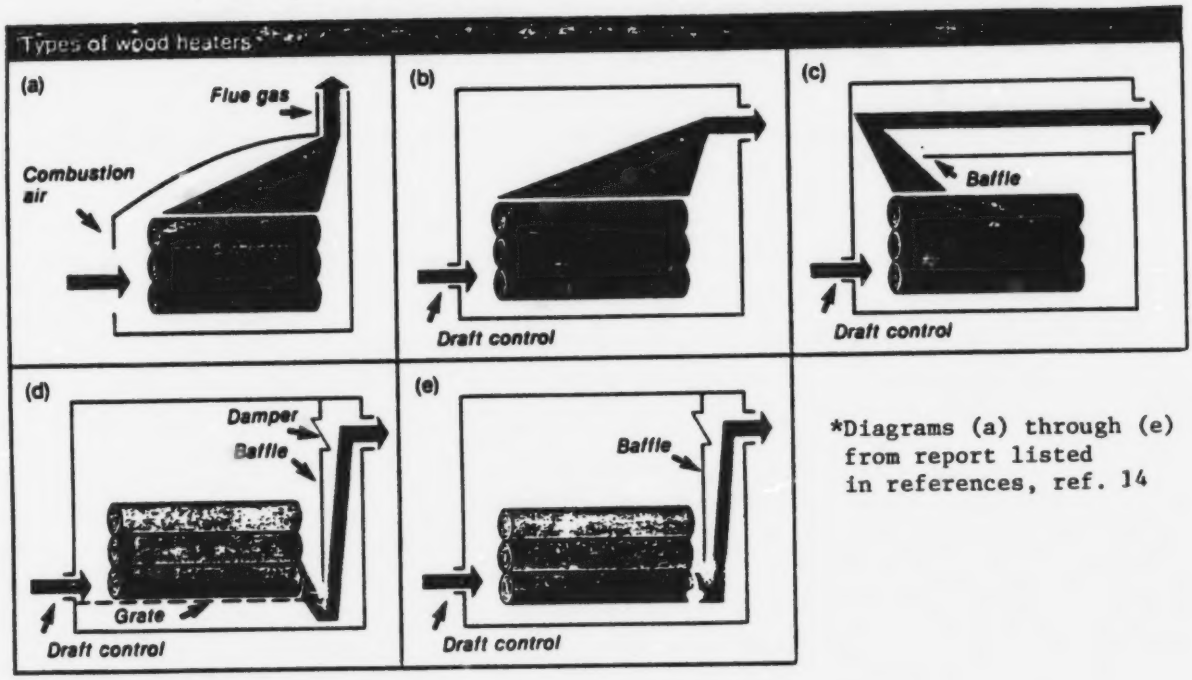
a) inefficient free standing (non-airtight) fireplace

b) airtight updraft stove (no internal baffle)

c) airtight horizontal baffle stove

d) airtight downdraft stove

e) airtight side draft stove



*Diagrams (a) through (e) from report listed in references, ref. 14

Updraft Stove

Combustion gases flow directly from the fire to the flue pipe, without any obstruction. Flames are often found more than a metre past the flue collar creating a potential fire hazard.

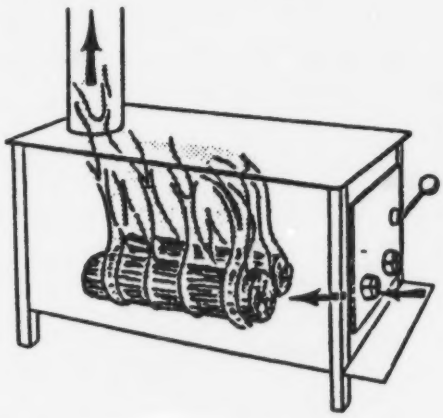
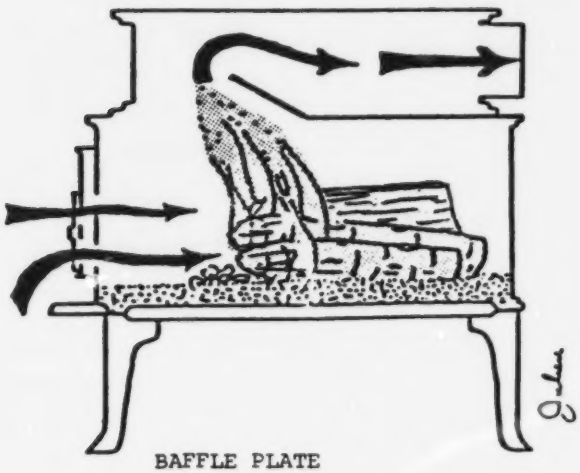
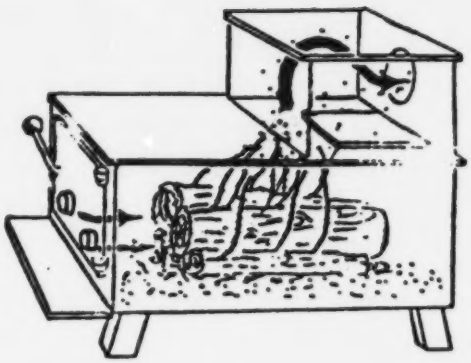


Diagram from: The Woodburner's Handbook, as listed in references, ref. 1. Reprinted with permission of the publisher.

Horizontal Baffle or 'S' type flow pattern Stove



BAFFLE PLATE

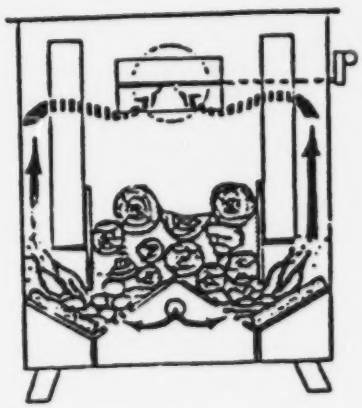


A HEAT EXCHANGER: adds on extra surface and increases the heat transfer to the room

The baffle plate or heat exchanger slows down gas flow in the stove and maintains higher temperatures in the firebox. Flames are less likely to be found in the flue pipe.

Downdraft Flow Pattern Stove

The Vermont Downdrafter is the only stove identified that falls in this category. The unit features a reverse combustion gas flow pattern. Gases are produced in the fuel chamber and travel through the coals before leaving the stove. At high combustion rates, with a good bed of coals, almost ideal conditions are created for complete combustion of volatiles.



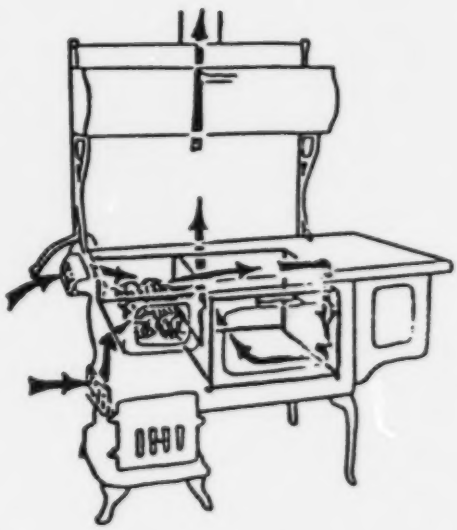
Diagrams from: The Woodburner's Handbook, as listed in references, ref. 1. Reprinted with permission of the publisher.

Sidedraft Flow Pattern Stove

The combustion gases leave the firebox very close to the coal bed, thereby increasing the chance of ignition, favoring complete combustion. Some units divert combustion gases through the lining in the double wall in the back of the stove to increase heat transfer and to maintain higher temperatures in the firebox.

Cookstoves

Most cookstoves are not very efficient heaters. Very few have reasonably controlled combustion air inlets, and have numerous uncontrolled air entrances such as the cooking plates or the ash door. Combustion chambers are rather small and few are airtight. The main purpose of a cookstove is to produce a reasonably regulated heat for cooking. They have not been designed for heating a whole house. In most of these stoves, flames can be diverted around the oven to slow down combustion gases and increase the heat exchange surface, to increase efficiency. Some new cookstoves available on the market are relatively airtight and are of sturdy construction. They are high priced and can be justified only if used for cooking on a regular basis.



Diagrams from: The Woodburner's Handbook, as listed in references, ref. 1. Reprinted with permission of the publisher.

The comparative operating efficiencies of the various stove flow patterns are illustrated in Figure 4.2/1. The efficiency ratings are based on standardized laboratory test methods and controlled conditions. Poorly maintained units can be expected to achieve significantly lower efficiencies.

Woodstoves that illustrate some of the preferred characteristics cited earlier are presented on the following pages. Their inclusion is not meant to endorse or imply endorsement of the particular stove models or the manufacturers.

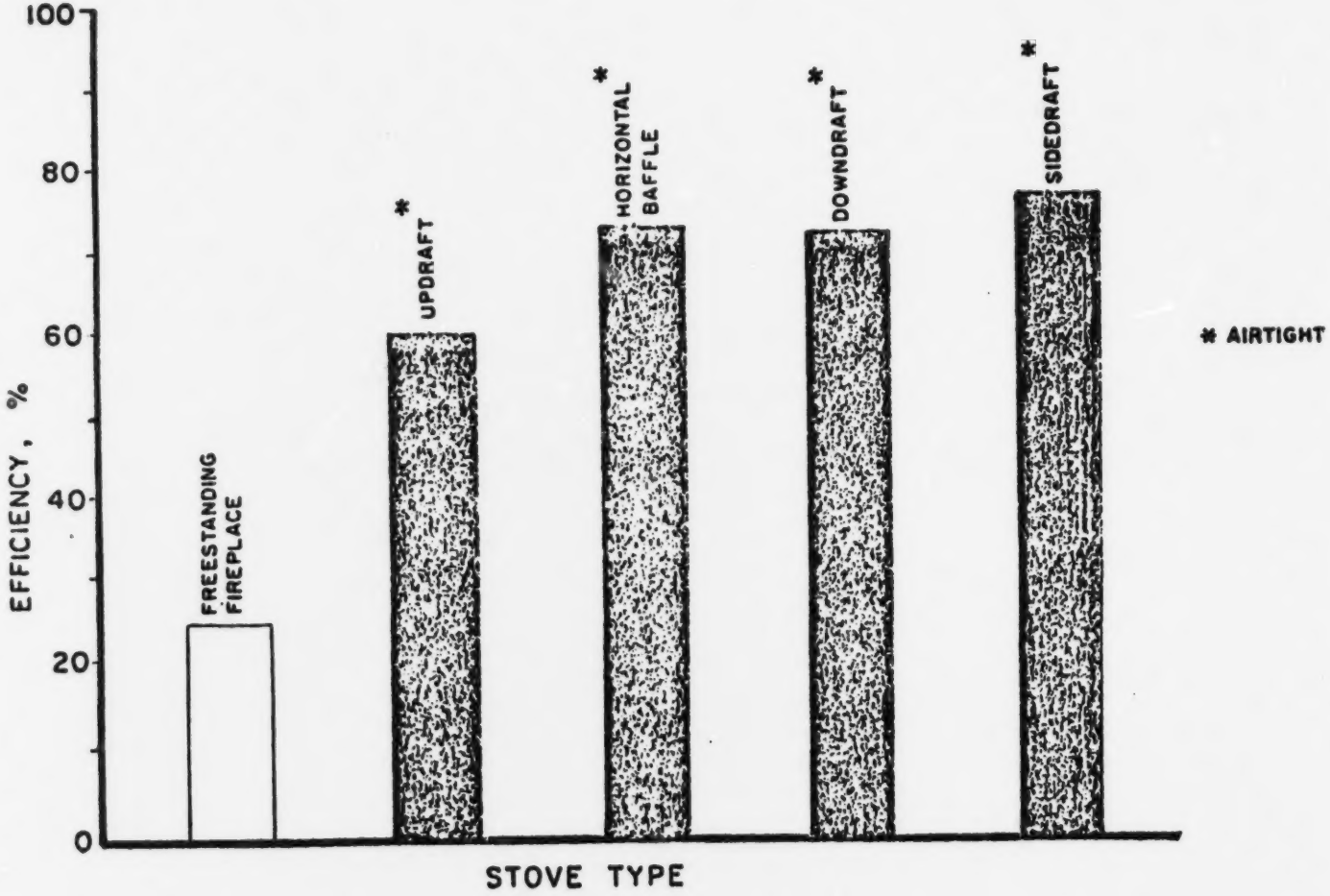
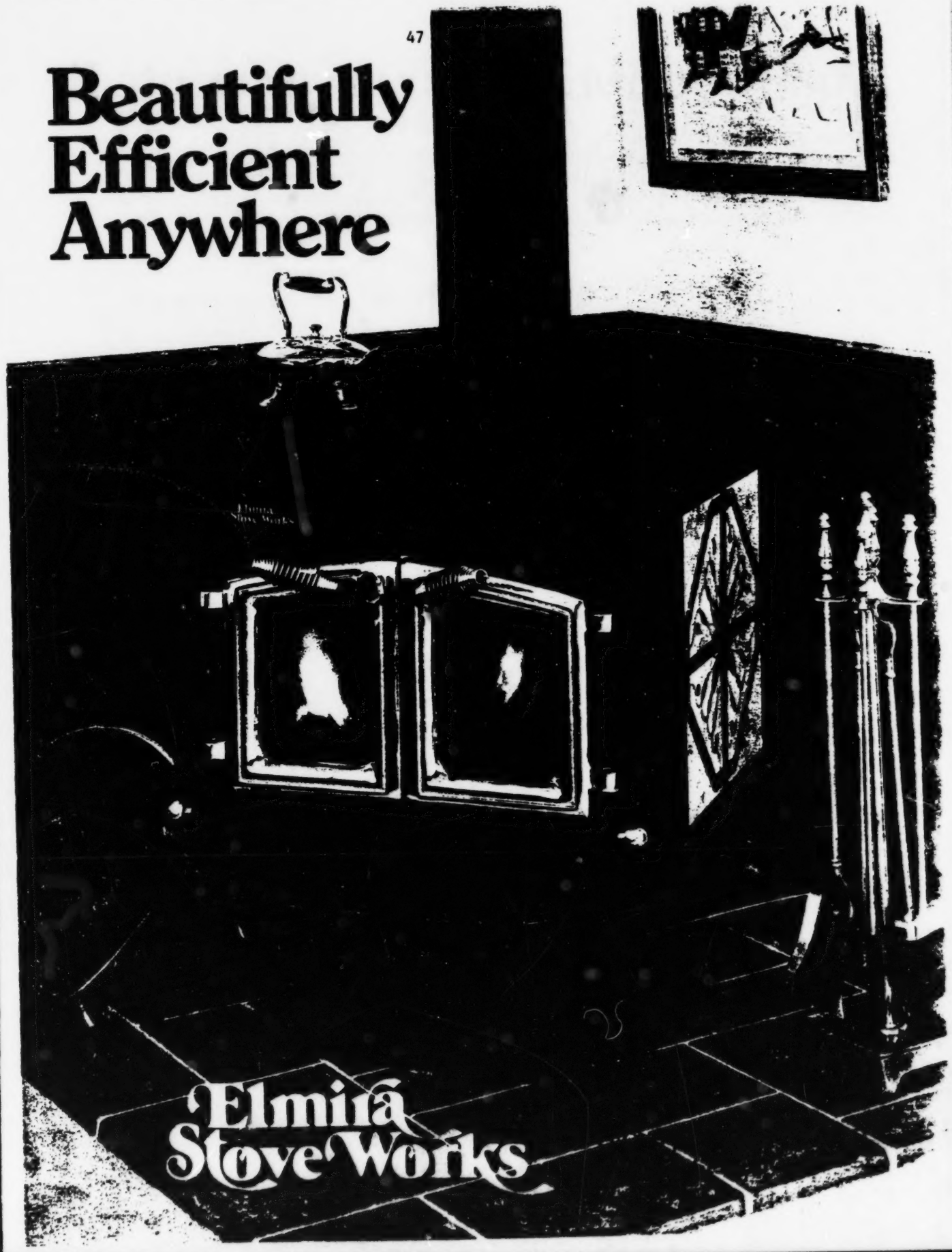


Figure 4.2/1 APPLIANCE EFFICIENCY OF DIFFERENT STOVE TYPES Source: Reference 14

Beautifully Efficient Anywhere



Finally, everything you ever wanted!

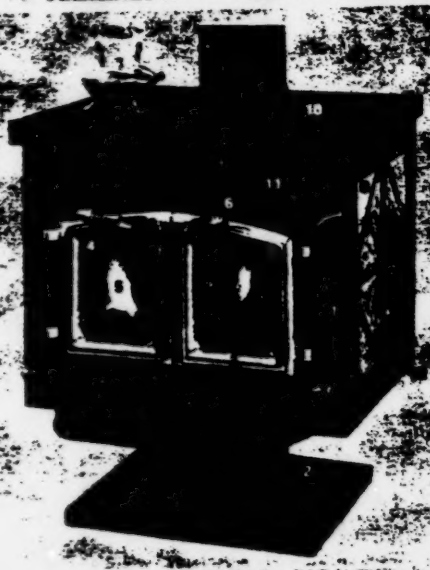
Imagine a stove you can install almost anywhere, with beautiful Ceramic tile side walls that reduce rear clearance to 6". A stove with unique "glass wash" that keeps the Corning Pyro Ceram® glass clear so you will never loose sight of the fire. Picture [illegible] 24 Karat gold plated cast iron doors [illegible] brass doors, never to tarnish. This stove [illegible] new heating, cooking and [illegible] versatility to the best investment [illegible]

TILE STOVE Features

[illegible] and heatshield [illegible] clearances to within 6" of [illegible] inside or outside [illegible] air, [illegible] home [illegible]

[illegible] cast iron doors [illegible] guaranteed [illegible] to tarnish.

3. Unique airflow glass wash system, keeps windows clear of soot build up automatically.
4. High temperature Corning Pyro Ceram® viewing windows maximizes fire visibility.
5. Airtight construction for a long burn.
6. Adjustable primary air control regulates the fire for desired heat output.
7. Airflow, glass wash control.
8. Ceramic tile included.
9. Removable heating grid for stove top cooking.
10. Internal baffle for secondary combustion.
11. Optional blower circulates warm air at the rate of 200 cu. ft. per min.



WARRANTY

The Elmira "Tile Stove" and "Stepstove" are warranted against defects in material and workmanship for a period of 5 years. Consult your dealer for details. Elmira Stoves are tested by Warnock Hersey Professional Laboratories to ULC 627 and UL Standards 1482.

SPECIFICATIONS

	TILE STOVE	STEP STOVE
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	31"
[illegible]	[illegible]	22"
[illegible]	[illegible]	25"
[illegible]	[illegible]	[illegible]
[illegible]	17" x 10¼"	17" x 10¼"
[illegible]	16" wide 17¼" deep 12" high	Same
Log Size	16"	16"
Weight	380 lbs.	320 lbs.
Flue Size	7"	6"
Heating Capacity	1250 sq. ft.	1250 sq. ft.
Heat Output (approx.)	50,000 BTU's per hr.	Same
Fireplate Angle	1¼"	1¼"
Clearance Sides	10"	24"
Clearance Rear	6"*	6"*

*when installed with a UL or ULC approved stove E connector pipe

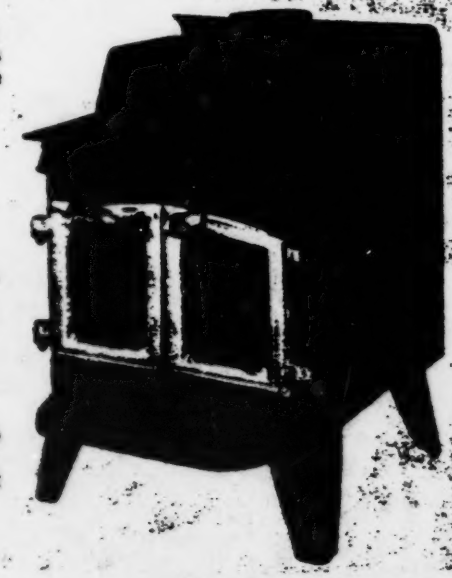
Combustion Air	Inside/ Outside	Inside
Base	Pedestal	Leg
Blower (200 C.F.M.)	Optional	Optional
Black Cast doors	N/A	Standard
Gold Doors	Standard	Optional
COSP No.	WUE 008	WWE 010

STEPSTOVE

The Elmira Stepstove is built to the same [illegible] of quality and workmanship as the Elmira "Tile Stove" and represents the same good value.

Features

- Unique airflow glasswash system, keeps windows clear of soot buildup automatically.
- High temperature Corning Pyro Ceram® glass maximizes fire visibility.
- Airtight construction for a long burn.
- Spin draft air-intake control regulates the fire for desired heat output.
- Internal baffle for secondary combustion.
- Versatile two level cooking surface.
- Rear heatshield reduces clearances to within 6" of combustibles.
- Optional blower circulates warm air at the rate of 200 cu. ft. per min.



An optional catalytic combustor is available for both the Tile and Step Stove to reduce emissions, creosote and increase burning efficiency.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

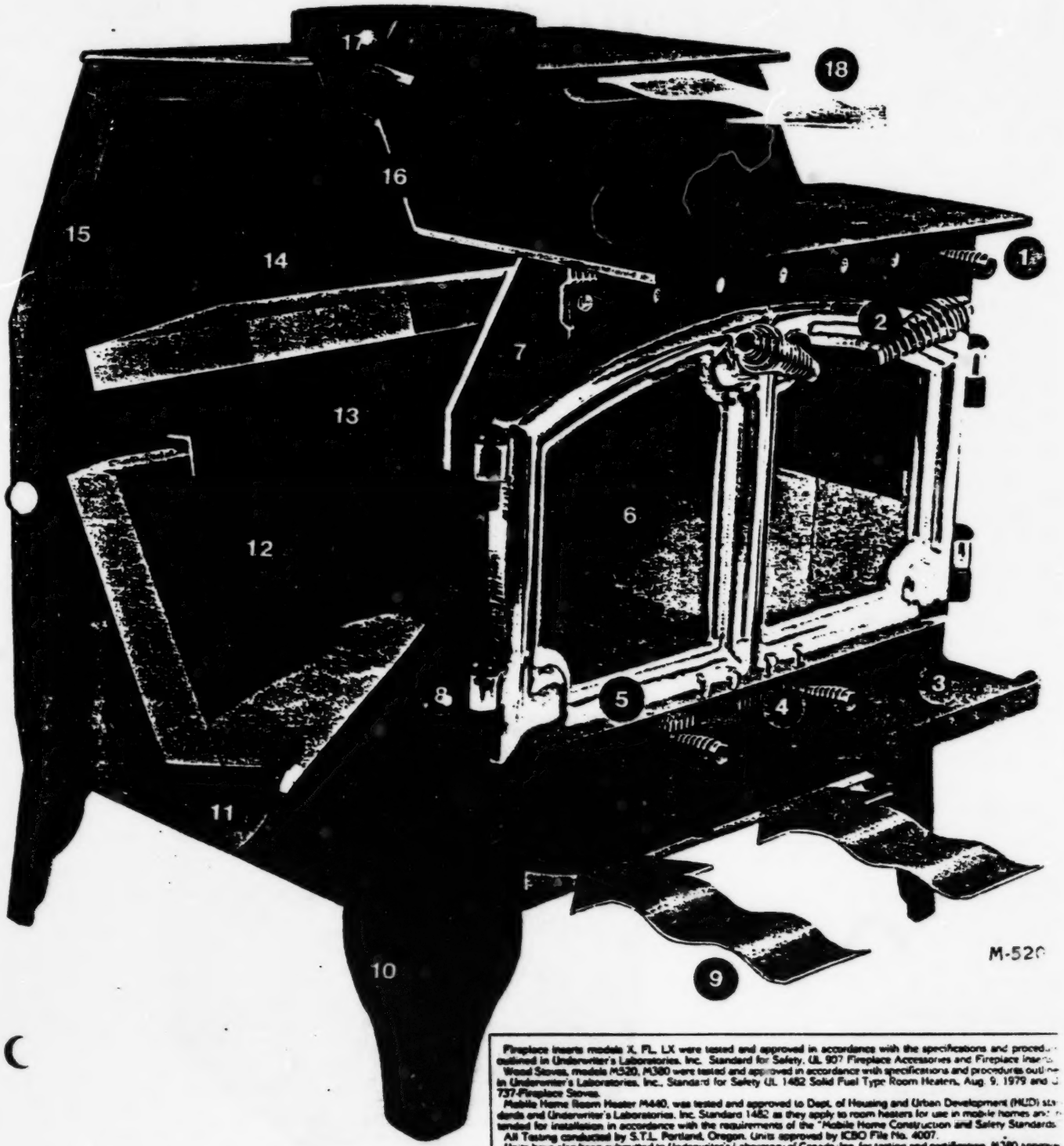
Elmira Stove Works

22 Church St., Elmira, Ontario N3B 1M3
Telephone (519) 669-5109

AVAILABLE AT:

PRINTED IN CANADA

LOPI Quality on the Outside...
...Follows Through to the Inside



Fireplace inserts models X, FL, LX were tested and approved in accordance with the specifications and procedures outlined in Underwriter's Laboratories, Inc. Standard for Safety, UL 907 Fireplace Accessories and Fireplace Inserts.

Wood Stoves, models M520, M380 were tested and approved in accordance with specifications and procedures outlined in Underwriter's Laboratories, Inc., Standard for Safety UL 1482 Solid Fuel Type Room Heaters, Aug. 9, 1979 and UL 737-Fireplace Stoves.

Mobile Home Room Heater M440, was tested and approved to Dept. of Housing and Urban Development (HUD) standards and Underwriter's Laboratories, Inc. Standard 1482 as they apply to room heaters for use in mobile homes and intended for installation in accordance with the requirements of the "Mobile Home Construction and Safety Standards."

All Testing conducted by S.T.L. Portland, Oregon. Units approved by ICBO File No. 4007.

Units have also been submitted to Underwriter's Laboratory of Canada, Inc. for testing and certification. M380 approved to ULC Standard 1482-File No. S627-M1981 and approved for credit by the Canadian Oil Subsidization Program.

Consult local building code officials prior to installation

Inside Information

U.S. and Foreign Patents Pending

Canadian Register Industrial Design Rd 1981 48362

OUTSTANDING FEATURES

(1) SECONDARY DRAFT CONTROLS
Secondary Draft controls promote more complete combustion of volatile gasses, increasing efficiency and minimizing creosote build-up. This allows for greater flexibility in the control of the fire. The Secondary Draft Controls also work in conjunction with our unique baffle to create conditions in which secondary combustion can take place, allowing for more thorough burning of volatile gasses which would otherwise escape up the flue.

(2) OPEN SPRING HANDLES
Available in Brass or Nickel, that are cool to the touch on all points of contact.

(3) ASH FENDER
Our specially designed ash fender is equipped with a spill-proof lip and a cutaway opening for easy cleaning. Note how the radius matches and complements the lines of the stove.

(4) PRIMARY DRAFT CONTROLS
The primary draft controls offer precision control of the fire. It directs primary air to the fuel, providing even control over the start-up and combustion rate of the fire.

(5) CAST IRON DOORS
Gracefully designed, cast iron doors are fully gasketed with non-asbestos rope for an air-tight seal. Select from Jet Black cast iron, Nickel plated or gleaming Brass. The door handles are a precision stamped part, with no unsightly washers welded to a round bar. This attention to detail has earned our reputation for superiority.

(6) GLASS
Clear, high impact ceramic glass is fully gasketed and tested to withstand 1400°F continuous heat and 1800°F intermittent. This provides safe fire viewing, without the intrusion of a metal screen and provides a long, unobstructed view of the burning fire.

(7) AIRWASH
The Airwash is designed to channel turbulent air across the glass. This reduces soot and creosote build-up, ensuring clean fire viewing.

(8) 5/8" HINGEPINS AND HEAVY HINGE ASSEMBLY
Rugged and clean, we pierce the stove face, drive the hinges through, then weld from the inside of the firebox. Thus providing two points of strength with no bulky unsightly hinge assembly. Hinge pins are also available in brass or nickel plating.

(9) COOL AIR INTAKE
Draws cool air from adjoining rooms into a convection chamber for additional heating capabilities.

(10) SCULPTURED LEGS
Stove legs aren't made of angle iron or pipe, but are custom formed to enhance the design of the unit.

(11) CONVECTION AIR CHAMBER
The unique convection chamber, the largest the market offers, is designed to operate independently of blowers. Cool room air is naturally drawn underneath and around the firebox to be returned to the room. This unrestricted natural circulation around the convection chamber transfers more heat into the living space and less potential heat is lost up the flue. Optional blowers can be added to enhance this system.

(12) FIREBRICK LINING
Increases internal temperature and protects steel from oxidation, insuring you for years of safe, reliable home heating.

(13) FIREBRICK RETAINER
Heavy-duty for sure placement and safety.

(14) FREE FLOATING REFRACTORY BAFFLE
All LOPI appliances, except the M-440, feature a baffle of masonry construction. This innovative baffle utilizes the thermal storage capacity of the brick to maintain higher internal temperatures. The baffle retains the unburned gases in the firebox and keeps the internal temperatures higher than a conventional steel baffle. Oxygen introduced by the secondary draft works in conjunction with the baffle to create conditions in which secondary combustion can take place. Such high temperatures and efficient combustion means the LOPI is able to generate a much greater heat transfer than other products on the market.

The large extended insert (LX) can produce up to 89,000 useful BTU's per hour, and the M-520 freestanding stove has been rated at 77,000 BTU's.

(15) 1/4" STEEL WALLS (RED)
Lopi carries the same heavy duty construction throughout the firebox. All Lopi appliances are of unibody construction with inside welds to produce a clean, attractive appliance. And with fewer components you're insured of lasting quality.

(16) 5/16" STEEL TOP (BLUE)
Most companies feel 3/16" or 1/4" steel is adequate for this top plate, but we insist on the heavier 5/16" for added strength and durability. With the extended and freestanding models, it serves as an ideal cook-top surface.

(17) FLUE COLLAR
Heavy duty flue collar, 8" inside diameter, for drip-free installation of pipe.

(18) WARM AIR EXIT
Natural disbursement of warm air into your room.

ADDITIONAL INSERT FEATURES:

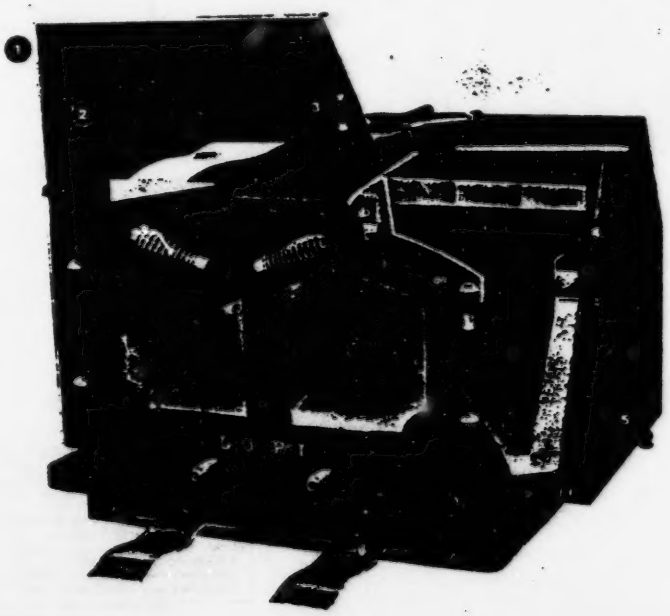
(1) OPTIONAL TRIMKIT
Brass or Nickel for further enhancement of a finely crafted product.

(2) FACING PANELS
Panels provide an air-tight seal for your fireplace opening. Panels are available in three sizes for the (LX) & (FL) models and two sizes for the (X) model.

(3) DAMPER CONTROLS
To "fine tune" the burn rate for a controlled, even, economical burn.

(4) OPEN SIDE AIR CHAMBERS
Promotes free air-exchange for increased convective circulation of warmed air.

(5) LEVELING BOLTS
For level placement into your fireplace.

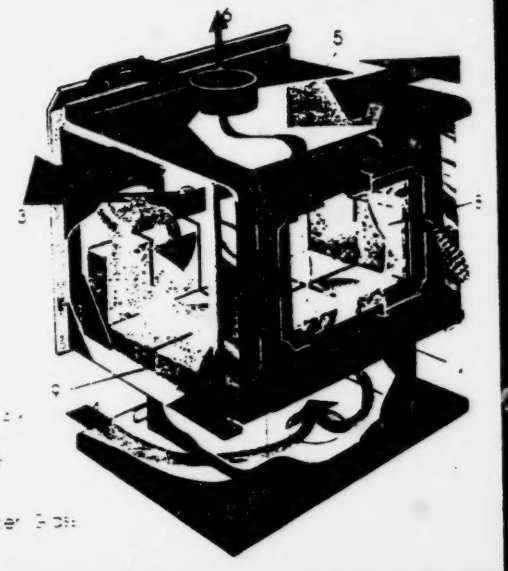


LX

The KITTENS

The compact *Kitten* and *Baby Kitten* allow those with smaller heating requirements to enjoy the economical benefits of an Osburn. Both stoves feature the same precision engineering and high quality construction found in all Osburns. The *Kittens'* efficient, radiant heating will help keep overall costs low.

KITTEN	HIGH	WIDE	DEEP	BABY KITTEN	HIGH	WIDE	DEEP
OVERALL DIMENSIONS	24"	20	26	OVERALL DIMENSIONS	24"	18"	22"
HEARTH SIZE		30	42	HEARTH SIZE		30	40
	SIDE	BACK	CORNER		SIDE	BACK	CORNER
CLEARANCE TO COMBUSTIBLES	40	36	36	CLEARANCE TO COMBUSTIBLES	40	36	36
FLUE SIZE 6"				FLUE SIZE 6			

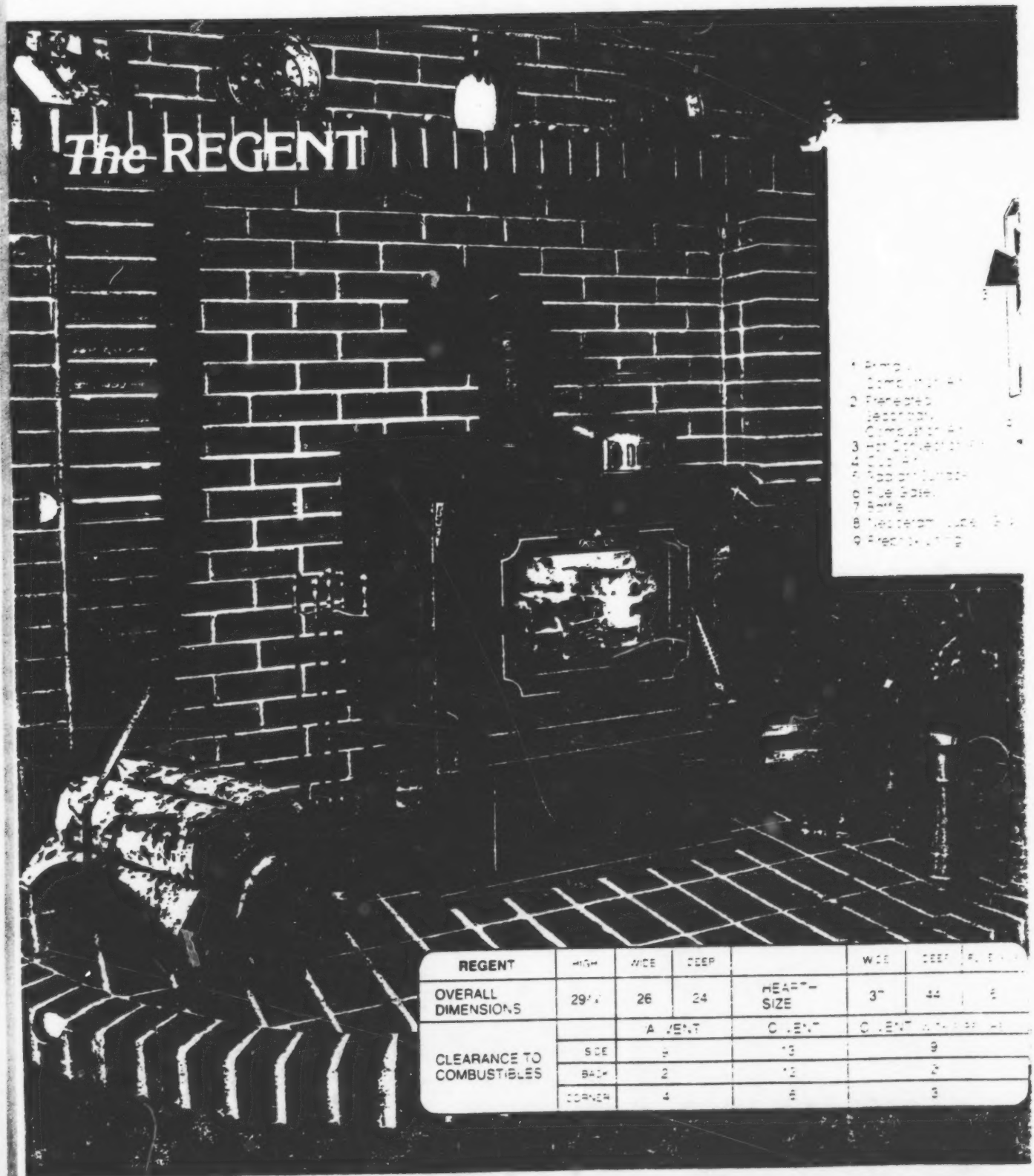


Osburn's mid-size stove heats up to 1,500 square feet. The efficient *Regent* provides a combination of double walled convection heating on sides and back and radiant heating through its top and front surfaces.

Osburn design and engineering means surprisingly low clearances. Install the *Regent* as close as *two inches* to combustibles at the rear, and *nine inches* on the sides. No special walls to build. Installation is fast and economical. In addition, the *Regent* is certified for installation in *mobile homes*.

Osburn's options include . . .

- Rear-mounted 240 CFM fan for forced air.
- Variable speed fan control.
- Outside air intake.



REGENT	HIGH	WIDE	DEEP		WIDE	DEEP	R.
OVERALL DIMENSIONS	29½	26	24	HEARTH SIZE	37	44	8
CLEARANCE TO COMBUSTIBLES		ALCOVE		CLOSET	CLOSET		
	SIDE	9		13	9		
	BACK	2		12	2		
	CORNER	4		6	3		

The VICTORIANAIRE

Osburn's largest stove is designed to heat up to 2,500 square feet. Wood? Coal? Your choice. The *Victorianaire's* versatile design accommodates both.

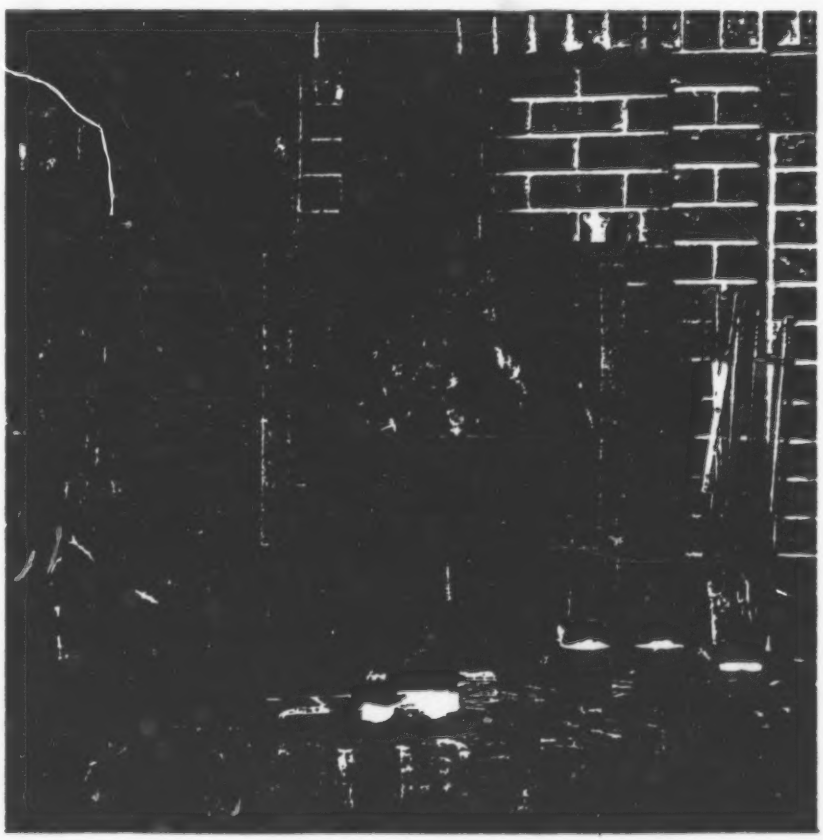
The built-in ash pan means convenient operation.

The *Victorianaire* combines double-walled convection heat with significant radiant heat through Osburn's top and front surfaces.

Osburn's options include . . .

- Rear-mounted 240 CFM fan for forced air.
- Variable speed fan control.
- Outside air intake.

	HIGH	WIDE	DEEP		SIDE	BACK	CORNER
OVERALL DIMENSIONS	31¾	29	22"	CLEARANCE TO COMBUSTIBLES	21½"	24"	17¾
HEARTH SIZE		40	46"		8" FLUE		



OSBURN

Nice Warm Friends

Friends you can *rely* on. No idle boast. We've backed up the statement with extensive research and design; dedicated work by people who are concerned about heating *efficiency. Safety.* And *appearance.* Our Osburn stoves are designed to satisfy a variety of heating needs. Each one, large or small, is a hard working, long lasting, good looking investment in comfort and economy.

The Osburn woodstove. A nice, warm *EFFICIENT* friend.

Each Osburn stove is designed to maximize the heating potential of its fuel. The *double wall* construction of Osburn's larger models allows for *convection* heating as well as surface *radiant* heating. That means more warmth from the same fuel, hour after hour.

EVERY OSBURN STOVE INCLUDES THESE EFFICIENCY FEATURES:

- Heavy steel construction means your Osburn stove is a long lasting friend.
- Cast door with gasket creates an *airtight* seal each time you close the door.
- ¼ inch internal baffle recycles hot gases for extra heat.
- Fire brick lining radiates the heat back into the fire to keep temperatures high, the combustion more efficient.
- Cooking surface keeps the coffee steaming . . . the stew bubbling, and the electric bills down!

4.3 WOOD FURNACES

Furnaces include the class of heating appliances that expell hot air for space heating purposes forced out by an internal air blower unit. Hot air furnaces typically have a heating capacity in the 50,000 to 200,000 BTU/hr range. Multiple furnaces or heating boilers are generally selected for larger heating loads. Three types of furnace units are considered in this case:

- o wood only fuelled furnaces
- o wood burning add-on furnaces to existing oil burning equipment
- o combination wood/oil burning furnaces

Combination Furnaces

This type of furnace is a single cabinet that contains a single fire box equipped to burn wood fuel and is fitted with an oil injector/burner to burn fuel oil. A single heat exchanger is used to transfer heat from the hot combustion gases to the room air forced through the exchanger by an air blower. One system of heat distribution ducts is used and one chimney is used. Thermostatic controls are in place so that if the wood fire subsides, and the room temperature decreases, the oil burner is activated. Wood/oil combination furnaces sometimes operate with a surplus of combustion "excess air" admitted around loading doors and the oil burner assembly. Operating efficiencies are reduced if too much air is admitted to the fire box.

Add-on Furnaces

Add-on wood burning furnaces are intended to be connected to the same supply ducts as an existing oil, gas or electric furnace. In the last couple of years a number of add-ons have been certified for use, provided manufacturers installation recommendations are closely followed. Potential safety problems can be created if the supply ducts of the oil furnace are not installed with the necessary clearances or insulation

required for wood burning units. It is possible to exhaust flue gases from both appliances using one chimney, provided the flue pipe is suitably sized and the wood burner's entry to the chimney is positioned below the oil furnace entry.

Wood Furnace Stokers

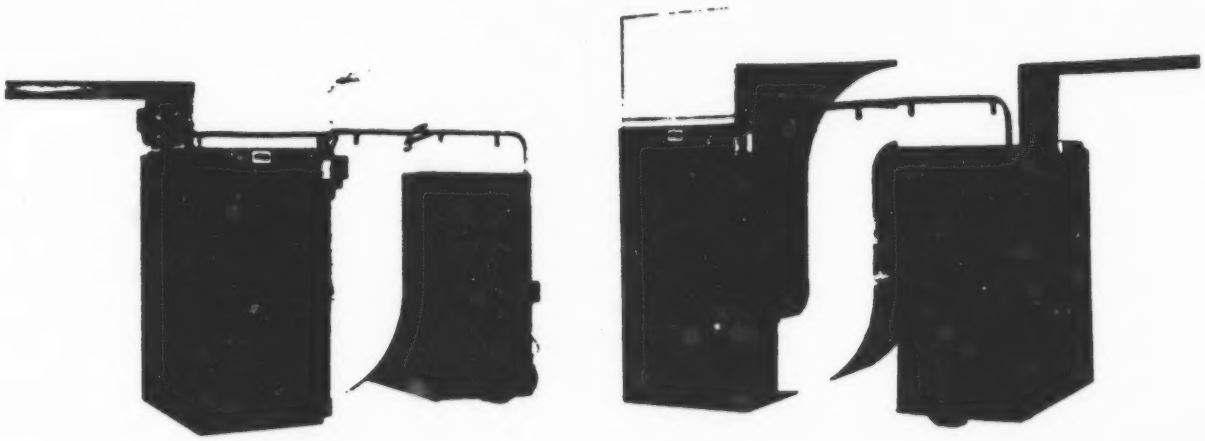
The wood fuel supply to certain types of wood furnaces can be automated by a mechanical stoker - refer to Section 4.5.

Product literature on various types of wood furnaces is enclosed for reference. Again, inclusion is not meant to imply endorsement of a particular product or manufacturer.

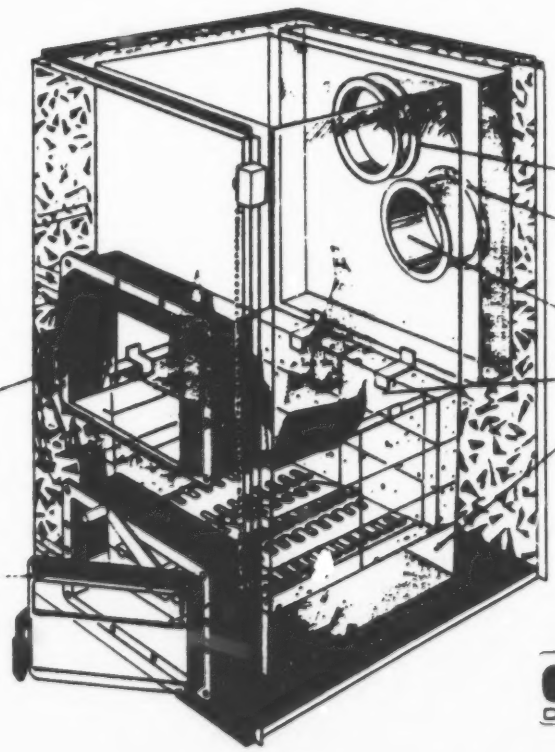
DUO-MATIC

CENTRAL HEATING WITH . . .

WOOD OR COAL ADD ON TO YOUR PRESENT OIL FURNACE



TWO DIFFERENT SYSTEMS FOR DIFFERENT APPLICATIONS



Firedoor and combustion chamber with the capacity to burn 18" logs

Ash pit door — easy access to convenient removable ash pan

Certified by C S A

Heavy duty welded construction

Secondary heat exchanger to extract the maximum amount of heat

7" diameter flue pipe

Firebrick lined

Heavy duty cast iron grates for wood or coal burning application. Shaker handle included

Buy Canadian

This Duo-Matic Warm Air Furnace Burns Either Wood or Coal for Economy and Conservation

DUO-MATIC Olsen

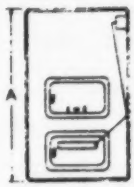
A Winning Combination

CWF-A & CWF-B

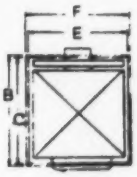
WOOD OR COAL ADD ON FURNACE

- **CWF-A** May be added on to an Oil Furnace having an oil input as shown on the original name-plate between 0.65 minimum and 1.20 maximum gph (U.S.)

- **CWF-B** May be added on to an Oil Furnace having an oil input as shown on the original name-plate between 0.75 minimum and 1.00 maximum gph (U.S.)



FRONT VIEW



TOP VIEW

REAR VIEW

NOTE. CWF-A and CWF-B can only be installed as shown in the diagrams below for the respective models.

FURNACE DIMENSIONS:

A = Furnace section height 52⅝".
B = Furnace section depth 33¾".
C×E = Hot air plenum 24⅛" x 31½".
F = Furnace section width 27⅝".
G = Flue pipe diameter 7".
H = Flue pipe to center furnace section 13⅜".
I = Flue pipe to center from floor 34½".

SHIPPING SPECIFICATIONS:

	CWF-A	CWF-B
Furnace Crate	1	1
Fire Brick Ctns.	2	2
Kit A	1	—
Accessory Carton	1	1
Kit B	—	1
No. of Pieces	5	5
Total Weight	510 lbs.	510 lbs.

SPECIFICATIONS:

- Solid Fuel Combustion Chamber with firebrick lining: 18" L x 17" W x 13½" H
- Fire Door: 16¾" W x 13½" H
- Ashpit Door: 16¾" W x 13½" H
- Insulated Cabinet: Foil faced mineral fibre
- Flue Outlet: 7"
- Output. Estimated maximum 120,000 BTUH
- Optional Gravity Fire Kit is available for use when firing the furnace during a power failure (Order Kit Model GFK).

WOOD ADD ON DUCT INSTALLATION

Fig. 1 SYSTEM A — MODEL CWF-A — STRAIGHT THROUGH PLENUM

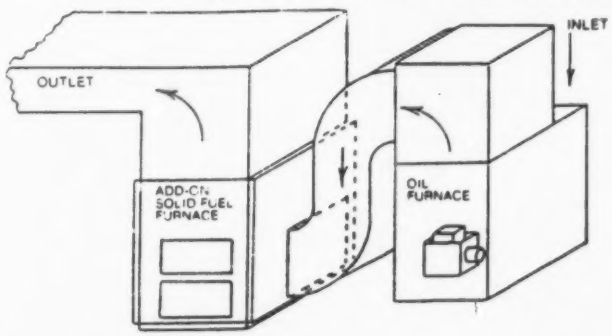
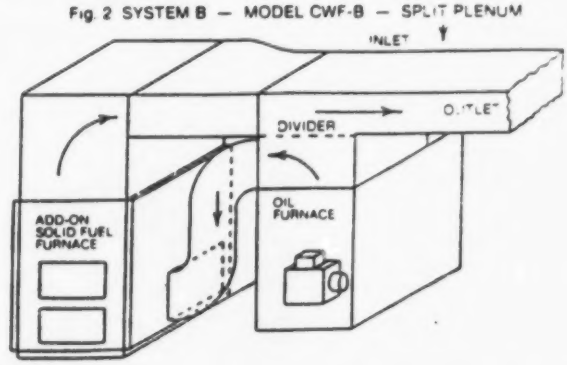


Fig. 2 SYSTEM B — MODEL CWF-B — SPLIT PLENUM



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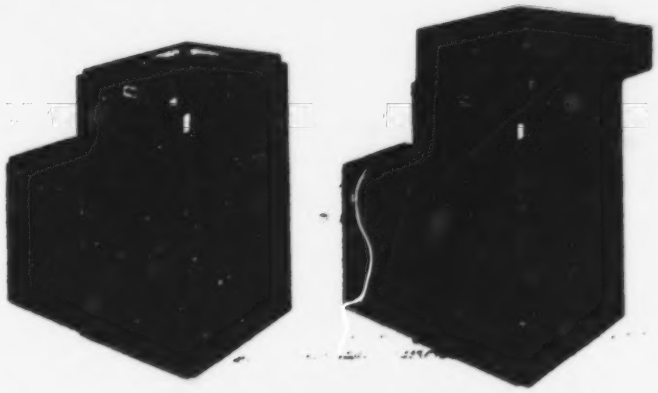
CENTRAL HEATING WITH . . .

WOOD OR COAL

COMBINED WITH ELECTRIC

Wood and Coal Fired Furnace
A free standing solid fuel furnace with it's own blower. If you have coal or firewood readily available, this is the ideal solution for reducing your heating costs. Save, and enjoy the advantages of a Forced Air System — Even Heat Distribution — and Automatic Thermostat Control.

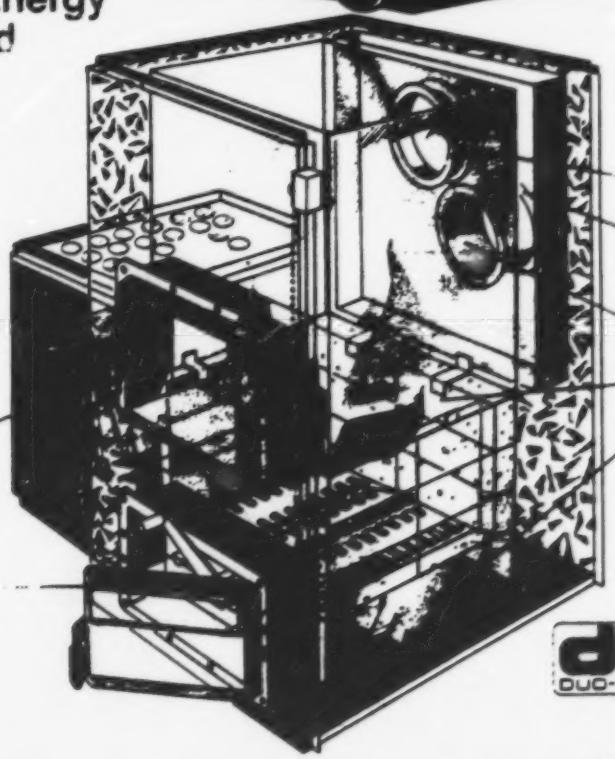


Wood, Coal and Electric Combination Furnace
A top mounted electric heat section makes the CWF-E a versatile combination. The electric section stands guard and maintains your house temperature when you are asleep or away. If ever it is not convenient to burn solid fuel, the electric section can satisfy all of your heating needs. Operates on a separate thermostat.

This Duo-Matic Electric Section Uses Electric Energy [illegible] and [illegible]

Certified by C.S.A

- Rigid cabinet design.
- Available in 15 Kw, 20 Kw or 25 Kw sizes.
- Elements guaranteed for 2 years.
- Separate thermostat control.
- Easy access service panel.



Regular size spun glass permanent filters.

Blower Section assembles on right or left hand side of heat exchanger.

Firedoor and combustion chamber with the capacity to burn 18" logs.

High capacity blower.

Ash pit door — easy access to convenient removable ash pan.

Heavy duty welded construction.

Secondary heat exchanger to extract the maximum amount of heat.

7" diameter flue pipe.

Firebrick Lined.

Heavy duty cast iron grates for wood or coal burning application. shaker handle included.

Buy Canadian

This Duo-Matic Warm Air Furnace Burns Either Wood or Coal for Economy and Conservation

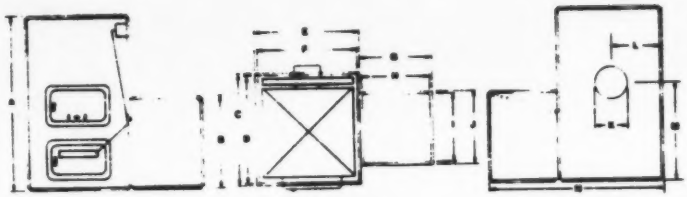
DUO-MATIC Olsen

A Winning Combination

CWF & CWF-E

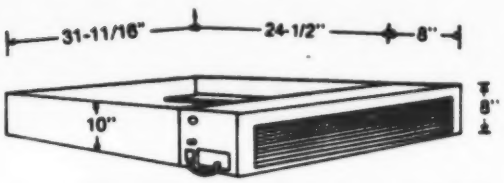
WOOD OR COAL FURNACE

WOOD COAL AND ELECTRIC FURNACE



FRONT VIEW TOP VIEW REAR VIEW

ELECTRIC SECTION DIMENSIONS:



NOTE: CWF-E is standard equipped with control box on right side (facing fire and ashpit doors) with blower section on left hand side. Optional reverse positions are available upon request.

FURNACE & BLOWER DIMENSIONS:

A = Furnace section height 52-5/8".
B = Blower section height 30-3/4".
C = Furnace section depth 33-3/4".
DxF = Hot air plenum 24-1/8"wx31-1/2".
E = Furnace section width 27-5/8".
G = Blower section width 21-1/8".
Hxl = Cold air plenum 19-1/4"wx18-1/8"l.
J = Blower section depth 20".
K = Flue pipe dia. 7".
L = Flue pipe to center furnace section 13-3/4".
M = Flue pipe to center from floor 34-1/2".

MODEL SPECIFICATIONS: Model	CWF	CWFE-15	CWFE-20	CWFE-25
Electric Section Heating Output B.T.U.H.	—	51,000	68,000	85,000
KW Rating	—	15	20	25
Volts	—	240	240	240
Total Line Current (Amps.)	—	70	90	113
Maximum Breaker (Amps.)	—	100	125	150
Blower Motor H.P.	1/4	1/3	1/3	1/3
Motor Pulley	3-1/4"	3-1/4"	3-1/4"	3-1/4"
Blower Pulley	6"	6"	6"	6"
20" x 20" Filter				

SHIPPING SPECIFICATIONS:

	CWF Complete	CWF-E
Furnace Crate	1	1
Fire Brick Cartons	2	2
Blower Carton	1	1
Accessory Carton	1	1
Element Carton	—	1
No. of Pieces	5	6
Total Weight	560 lbs.	630 lbs.

GENERAL SPECIFICATIONS:

- Solid fuel combustion chamber: Fire brick lined with cast iron grates. Size: 18" x 17" x 14"
- Firing Door: 16-3/4" x 13-1/2".
- Insulated Cabinet: Foil faced fiberglass.
- Flue outlet: 7".
- Blower: CFM-1200.
- Blower: 9" wheel type.
- External static pressure: 0.20 in. w.c.
- B.T.U.H. Estimated max.: 120,000. (Solid.)

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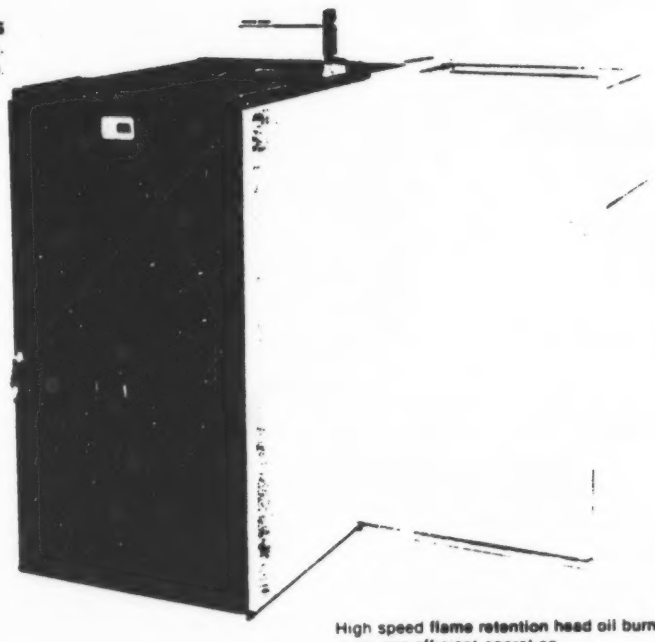
STANDARD SIZE PLENUMS
Provide **ease** of installation. now air conditioning is a simple addition.

Fibre ceramic chamber in oil section for greater efficiency and quiet operation.

Firebox sides and bottom lined with **heavy duty fire brick** rated for up to 3000°F

Large size dual purpose **fire** and **ash pit door.**

AUTOMATIC MOTORIZED DAMPER
Controls the primary air input and rate of combustion called for by the thermostat.



2 regular size spun glass **disposable filters.**

Blower section equipped with one large 12" blower can be installed on right or left hand side of furnace section

High speed **flame retention head oil burner** provides quiet and efficient operation.

APPROVED

B.B.C.

The Duo-Matic Base Burner Combination is today's answer to energy conservation and spiralling fuel oil prices. Use wood as your primary fuel. Keep your oil heating as a reserve or use whenever convenient as your alternate fuel. The Duo-Matic combination provides an excellent form of security and substantial savings.

DUAL THERMOSTATS — The B.B.C. is controlled by two separate thermostats. One for the wood burning side and one for the oil burning side. If, for any reason, the wood fire does not satisfy the house temperature called for, the oil burner cuts in to provide constant warmth.

POWER FAILURE — In the event of hydro failure, the wood burning section can continue to supply some heat to your home on the gravity principle. This means extra protection and security.

DUO-MATIC

A WINNING COMBINATION

DUO-MATIC

MODEL	B.B.C.			
**Bonnet Cap. BTUH	95,000	112,000	124,000	*136,000
Nozzle GPH	.85 - 80°	1.00 - 80°	1.10 - 80°	1.20 - 80°
Comb. Chamber	2FA	2FA	2FA	2FA
Air Filters	2 - 16 x 25 x 1	2 - 16 x 25 x 1	2 - 16 x 25 x 1	2 - 16 x 25 x 1
Ex. Static	.20	.20	.20	.20
Blower CFM	1016	1200	1325	1460
Blower Make	DELHI TORIN	DELHI TORIN	DELHI TORIN	DELHI TORIN
Motor Pulley	3¼ 3¼	3¼ 3¼	3¼ 3¼	3¼ 3¼
Turns Open	4 - T.O.	2 - T.O.	1 - T.O.	0 - T.O
Blower Pulley	8	8	8	8
Motor H.P.	1/3	1/3	1/3	1/3
Blower Size	G-12 1220-1	G-12 1220-1	G-12 1220-1	G-12 1220-1
Shipping Weight	760	760	760	760

* Multifired furnaces shipped with factory installed nozzle — can be changed within category for desired output.
** Bonnet capacity rating is for the oil side. Maximum output of solid fuel side is estimated at 120,000 BTUH.

A. FURNACE SECTION HEIGHT = 47¾"
B. WIDTH = 26¼"
C. FLUE PIPE TO CENTRE FROM FLOOR = 32"
D. FLUE PIPE DIA. = 7"
E. BLOWER SECTION WIDTH = 25"
F. DEPTH = 48½"
GxH. HOT AIR PLENUM = 24¼" x 24¼"
IxJ. COLD AIR PLENUNM = 23¼" x 23¼"

SHIPPING INFORMATION:

Your furnace is shipped in 5 pieces.

1. Furnace section complete with poker. Firedoor, fuel oil combustion chamber and fuel oil burner mounting plate are factory installed.
2. Blower section complete with filters, motor, belt and pulleys.
3. a) High speed burner, oil safety relay and 1.20 GPH nozzle. b) Control box with blower wiring harness, 24 volt transformer, relay for wood damper control, B.X. cable to wire oil burner into control system and fan/limit control prewired, mounted on bracket. c) Damper guard. d) Ash scoop. e) Brick retainers, shims and door sill guard. f) Solid fuel damper control motor (field wired) with linkage. g) Separate thermostats for solid and fuel oil sections. h) Flue draft regulator. i) Smoke baffle toolholder. j) Bag of miscellaneous fasteners.
4. Fire brick carton "C" containing 12 - 9" x 4½" x 2½" heavy duty fire bricks.
5. Fire brick carton "D" containing 18 - 9" x 4½" x 1¼" heavy duty fire bricks.

SOLID FUEL INDUCED AIR KIT - OPTIONAL — 1 carton containing induced fan mounting plate, strap, relay, necessary B.X. cable for field conversion and wiring instructions.

NOTE: Induced system must be wired by a qualified electrician or oil burner mechanic.

SPECIFICATIONS AND DIMENSIONS SUBJECT TO CHANGE WITHOUT NOTICE.

Canada's largest manufacturers of home comfort equipment

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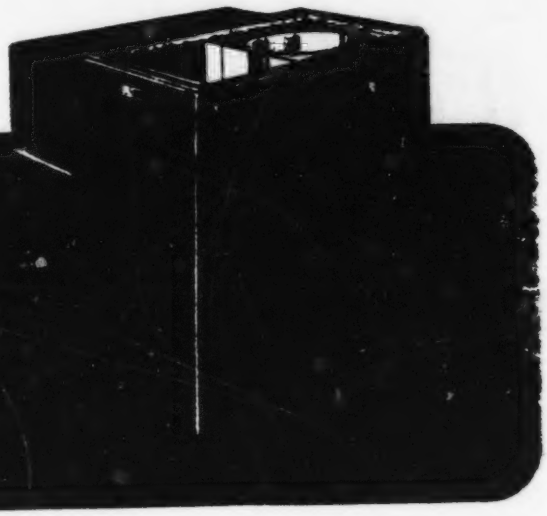
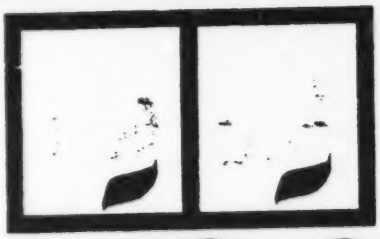
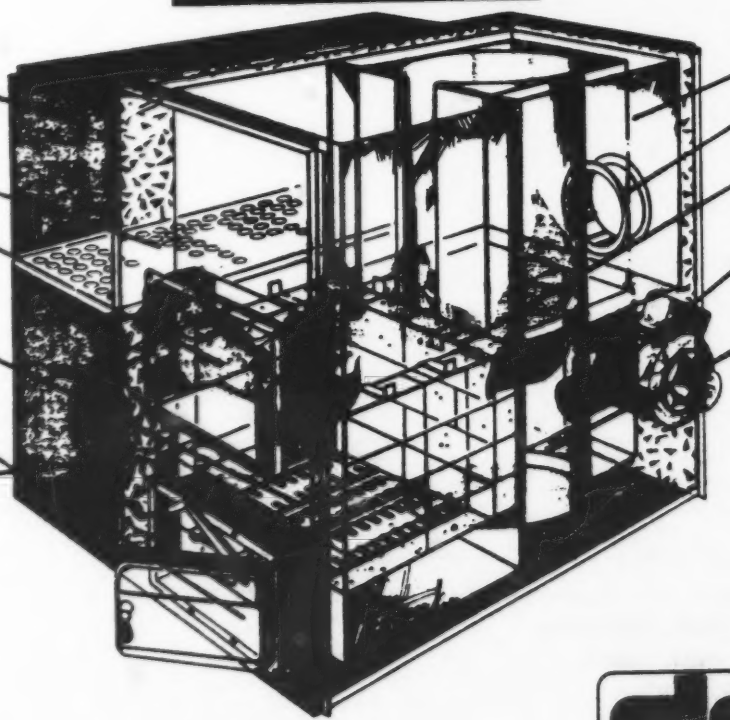
multi-fuel furnace



This side burns wood & coal



This side burns oil



Blower Section assembles on Right or Left Hand Side of Heat Exchanger

Regular size spun glass Disposable Filters

One piece air tight Doors

Cast Iron Grates— Heavy duty Cast Iron Grates can be used for wood or coal burning application. Shaker handle included

Ash Pit Door — Easy access to convenient removable ash pan

High capacity Twin Blower

Heavy Duty weld- construct

7" diameter Flue Pi

Fire Brick— Solid fu- side lined with 2 thick heavy duty Fir- Brick rated for up 3000

Flame Retention Hea Oil Burner with burn- mounted oil safet- relay

Fiber Ceramic Chambe in fuel oil sectio for greater efficienc

Quality built to las Certified by C S A

Buy Canadian

CWO-B —The combination coal-wood & oil forced air furnace which can pay for itself.

dm DUO-MATIC

MULTI FUEL FURNACES

• Dual combustion chambers • Dual thermostatic controls • Quiet, dependable operation • Your choice of fuels • Money SAVINGS!

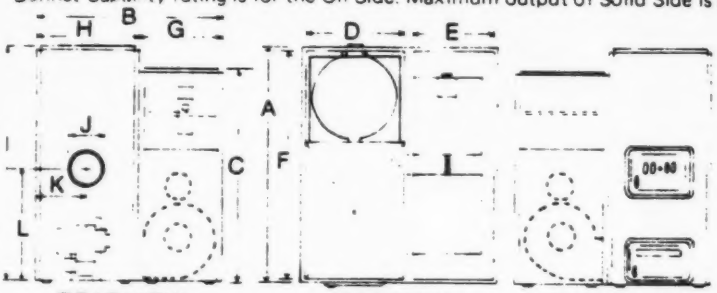
The Winning Combination

Specifications of the CWO·B

MODEL	CWO-B 112				CWO-B 140						CWO-B 168
** Bonnet Cap BTUH	*112,000		123,000		134,000		*140,000		151,000		168,000
Nozzle GPH	1.00 - 80		1.10 - 80		1.20 - 70		1.25 - 70		1.35 - 70		1.50 - 70
Comb. Chamber	2FA		2FA		2FA		2FA		2FA		2FA
Air Filters	2 - 16 x 24		2 - 16 x 24		2 - 16 x 24		2 - 16 x 24		2 - 16 x 24		2 - 16 x 24
Ex. Static	.20		.20		.20		.20		.20		.20
Blower CFM	1,200		1,320		1,440		1,500		1,625		1,800
Blower Make	DELHI	LAU	DELHI	LAU	DELHI	LAU	DELHI	LAU	DELHI	LAU	DELHI
Motor Pulley	3¼	3½	3¼	3½	3¼	3½	3¼	3½	3¼	3½	3½
Turns Open	2	2	0	0	1	1	½	½	0	0	0
Blower Pulley	9	9	9	9	8	8	8	8	8	8	8
Motor H.P.	¼	¼	¼	¼	⅓	⅓	⅓	⅓	⅓	½	½
Blower Size	G9-2 twin	2A9-9AC twin	G9-2 twin	2A9-9AC twin	G9-2 twin	2A9-9AC twin	G9-2 twin	2A9-9AC twin	G9-2 twin	2A9-9AC twin	G9-2 twin
Shipping Weight	970		970		970		970		970		970

*Multifired furnaces shipped with factory installed nozzle — can be changed within category for desired output

**Bonnet Capacity rating is for the Oil Side. Maximum output of Solid Side is estimated at 120,000 BTUH maximum



REAR VIEW TOP VIEW FRONT VIEW

A =Depth 48¼
B =Width 44⅛
C =Blower Section Height 45
D÷F=Hot Air Plenum 24 x 46
E÷F=Cold Air Plenum 16⅛ x 46⅛
G =Blower Section Width 18
H =Furnace Section Width 26
I =Furnace Section Height 51¼
J =Flue Pipe Dia. 7
K =Flue Pipe to Centre Furnace Section 13
L =Flue Pipe to Centre From Floor 35

SHIPPING INFORMATION

Your furnace is packed in 6 pieces

1. Furnace heat exchanger, complete with fire and ash pit doors, ash pan, grate bars, burner mounting plate, fire oil combustion chamber, panels including heat exchanger spacer panel, pokers, brick guard, brick shims and brick retainers
2. Blower section (can be mounted left or right hand) complete with blower, miscellaneous parts bag, filters and centre panel for heat exchanger section
3. (a) Burner with flame retention head and oil combustion safety control
   (b) Field wiring junction box with transformer, solid fuel relay, blower wiring harness, burner cable and fan limit control with support
   (c) Belt and pulleys
   (d) Solid fuel damper motor
   (e) Thermostats for solid fuel and oil
   (f) Smoke baffle tool
   (g) Blower motor
   (h) Draft regulator
   (i) Shaker handle
4. 5 and 6. Three cartons containing a total of 30 firebricks

*U.S. shipments are made up of 7 pieces. The burner with primary relay, blower motor, belt and pulleys are packed in a separate carton

SPECIFICATIONS AND DIMENSIONS SUBJECT TO CHANGE WITHOUT NOTICE

Canada's largest manufacturers of home comfort equipment.

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Tel. (604) 596-6201
QUEBEC
8200-8210 Avenue de l'Industrie, Ville d'Anjou, P.Q. H1J 1S7
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UNITED STATES
9442 Harrison Street, Romulus, Michigan 48174
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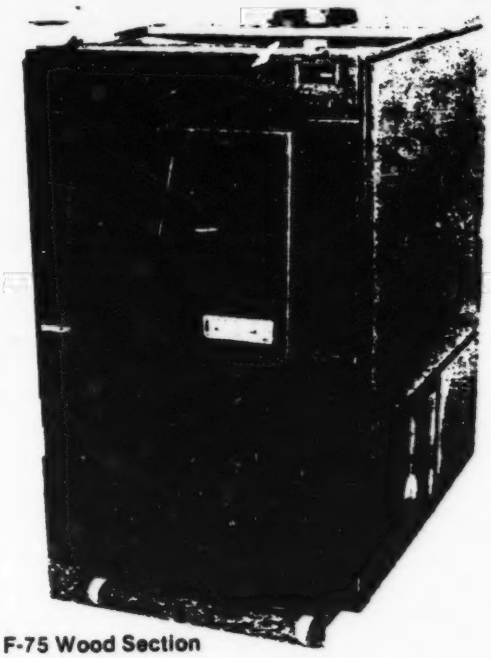
RSF ENERGY

F-75 W Forced-Air Wood Furnace
F-75 W/E Wood/Electric Combination
F-75 W/A Add-on to existing oil furnace



F-75 Wood Section

Specifications — wood furnace

Down-draft forced-air furnace

Rating — 3,000 to 75,000 BTU/hr.
Heating capacity — up to 2,500 sq. ft.

Height — 43"
Width — 28"
Depth — 40"
Flue size — 7"
Weight — 500 lbs.
Lining — brick

Recommended fuel — Wood only
Firewood size — 10" dia. x 20" long
Fuel capacity — 6 cu. ft.

Colour — Midnight Brown

Options:
— Domestic hot water heating coils
— Catalytic combustor

F75 applications:

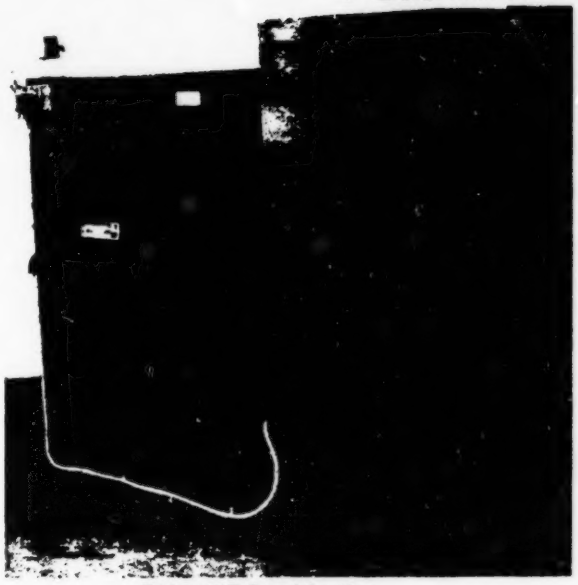
1. Forced-air furnace
Requires a) F-75 wood section
b) Thermostat kit
c) Blower

Wood/Electric Combination
Requires a) F-75 wood section
b) Wood electric thermostat kit
c) Nortron Electric furnace Model 21F. Available in 10, 15, 20 Kw sizes.

3. Add-on to oil
Requires a) F-75 wood section
b) Add-on thermostat kit

4. Gravity furnace
Requires a) F-75 wood section only

F-100 W Forced-Air Wood Furnace
F-100 W/E Wood/Electric Combination
F-100 W/A Add-on to Existing Oil Furnace



F100 W/E Combination

Specifications — Wood furnace

Down-draft forced-air furnace

Rating — 5,000 to 100,000 BTU/hr.
Heating capacity — up to 4,000 sq. ft.

Height — 46"
Width — 30"
Depth — 42"
Flue size — 8"
Weight — 775 lbs.
Lining — brick (200 lbs.)

Recommended fuel — Wood only
Firewood size — 15" dia. x 26" long
Fuel capacity — 10 cu. ft.

Colour — Midnight Brown

Options:
— Domestic hot water heating coils
— Corning catalytic combustor

F-100 applications:

1. Forced-air furnace
Requires a) F-100 wood section
b) Thermostat kit
c) Blower

2. Electric Combination
Requires a) F-100 Wood section
b) Wood Electric thermostat kit
c) Nortron Electric Furnace Model 21FA available in 10, 15 & 20 Kw sizes.

3. Add-on to oil
Requires a) F-100 wood section
b) Add-on thermostat kit

4. Gravity furnace
Requires a) F-100 wood section only

For THE SERIOUS WOOD BURNER

1. Fire brick
2. Outer door
3. Fusible link
4. Draft control
5. Insulation
6. Fortex seal
7. Bypass damper
8. Adjustable centre push door
9. Cook top
10. Inner door
11. Bimetallic thermostat
12. Convector side panels
13. After burner
14. Primary air heat exchangers
15. Secondary air heat exchanger
16. Progressive cross draft angles

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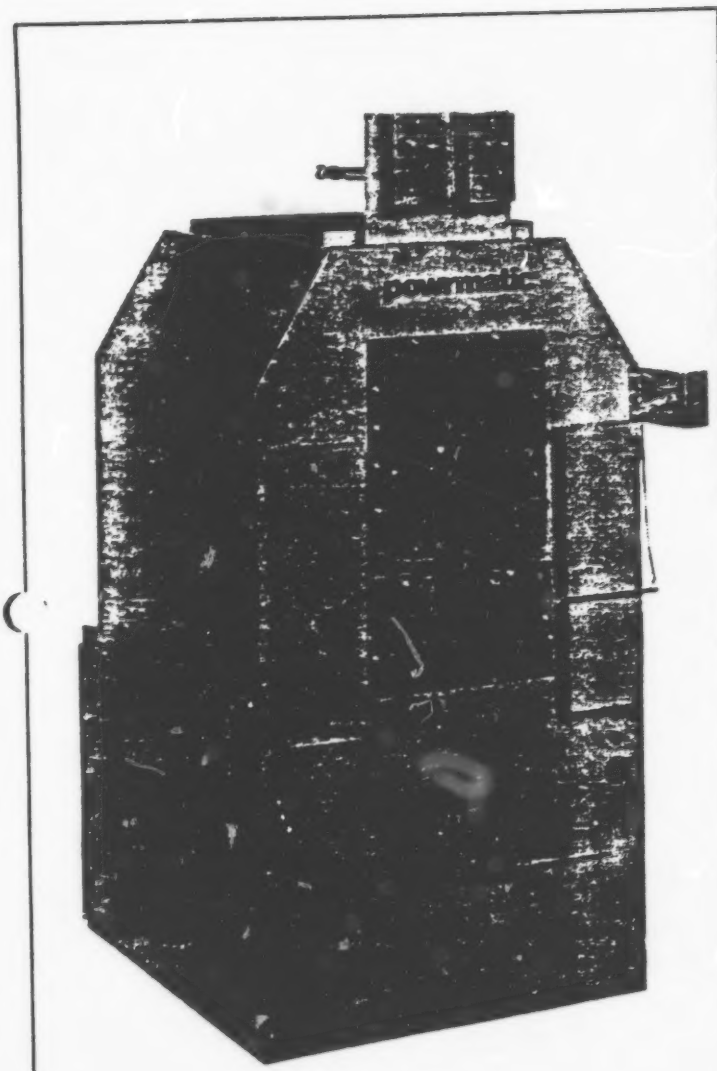
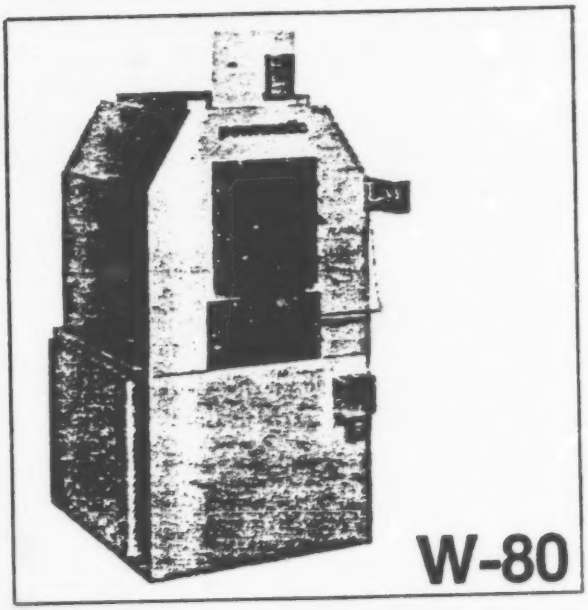
"HEAT FOR THE NORTH"

INSTALLATION AND SERVICE MANUAL

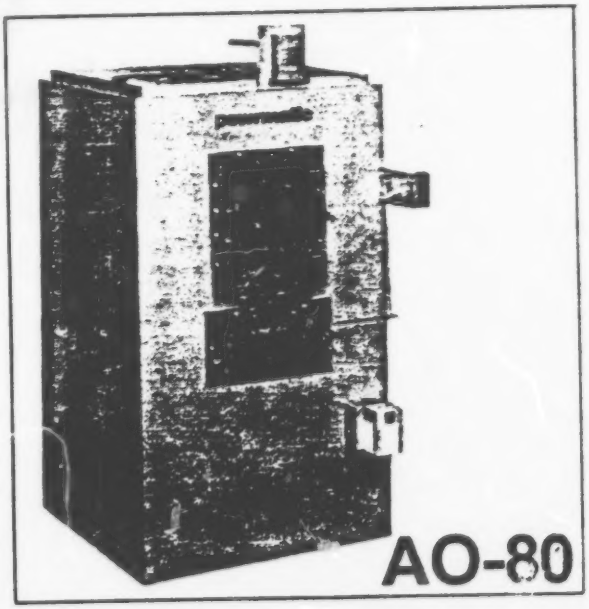
MODELS: EW - W - AO



EW-20, 18, 15, 10



W-80



AO-80

powrmatic

MODELS: EW-20, 18, 15, 10
W-80
AO-80

"OWNERS INSTALLATION INSTRUCTIONS
(SAVE THESE INSTRUCTIONS)

FUEL: Electricity and wood only

ELECTRICAL RATING:
— Electric: 240V — 3 wires - 60 hz (Models EW)
— Wood: 110V — 2 wires — 60 hz (Model W-80)

USE AS:
— Combination electric/wood furnace (Models EW)
— Wood furnace only (Model W-80)
— Electric furnace only
— Wood furnace add-on

INTRODUCTION

Your furnace was manufactured in accordance to our traditionally high standards for quality and reliability. The recommendations in this manual designated to give the maximum flexibility in using the fuel as noted while assuring safe and reliable operation.

MODEL

EW = Electric/Wood

W = Wood

AO = Wood Add-on to Oil

MANUFACTURED BY
POWRMATIC OF CANADA LTD.
TERREBONNE, P.Q., CANADA J6W 1Z9

1. BEFORE INSTALLING THE FURNACE

- If in doubt, contact your local heating dealer.
- Check for compliance to clearance specifications as recommended on name plate attached to the furnace casing.
- Keep flue pipe as short as possible. 6 in. dia. of 24 gauge thick is recommended for this unit and clearance shall be 18 in. to combustible.
- This appliance should be connected to a suitable chimney.
- The appliance should be placed on a non-combustible floor such as concrete to respect the clearances specified.
- The installation of the equipment shall be in accordance with the regulations of authorities having jurisdiction on installation code for solid fuel burning appliances and equipment and the C.S.A standard B365.

2. SAFETY MEASURES

- Dry wood shall be used since it provides cleaner and more efficient burning with less soot deposit, creosote, and ash residue as well as less frequent firing intervals.
- Do not use an automatic stoker.
- Do not use chemicals or fluids to start the fire.
- Do not burn garbage, gasoline, naphtha or engine oil.
- Do not store fuels closer to furnace than the minimum allowance for combustible materials.
- Remove ash residue when the ash drawer is full. First make certain fire is completely out. Pull ash drawer and empty it into a steel container with tightly fitting lid and remove outdoor other waste shall not be placed in this container.
- The furnace needs to be cleaned frequently because soot, creosote and ash may accumulate (see further instructions).
- Always keep the firing door and ash pan tightly closed and ensure that all gaskets are in good condition (if adjustment needs to be done, call the furnace installer).
- When combustion air damper is in down position, it must seal tightly with no restriction by the chain.
- Check daily for creosote build up into furnace until experience shows how often cleaning is necessary.
- Check chimneys periodically for creosote and soot accumulation.
- Do not install a manual flue damper with this furnace.
- When the loading door is opened you should always open it slightly before you fully open it. This allows oxygen to enter and burn any combustible gases that are present.

3. CHIMNEY & FLUE PIPE

- Use a chimney suitable for solid fired fuel appliances.
- Flue pipe should have a gradual rise of not less than ¼ in. per foot from furnace to chimney.
- All joints must be securely fastened at least with 3 metal screws and then cemented.
- Do not install any hand operated damper in flue pipe, use a barometric damper
- Connect the furnace to an approved factory built chimney which is of equal or greater size than furnace outlet. If a masonry chimney is used, it must be clean and in sound condition. Flue pipe must not extend into the chimney. Never tee the furnace to another flue pipe.
- The flue pipe must be installed in accordance with the local requirements.
- Do not use galvanized flue pipe. Use only black iron flue pipe of min. 24 ga. thickness. Never use flue pipe smaller than the flue collar of the appliance.

4. INSTALLATION

Components must be installed in accordance with the following:

- Position the automatic air damper motor as per fig. #1. Hook the end of chain in the arm hole of damper door and the other end to the damper motor arm. The chain must be adjusted so that when the damper motor arm is in up position, the air damper will have a maximum opening of 2¼" in. and it should not be altered to increase firing for any reason. Ensure that damper closes tightly.
- Install the barometric damper in the flue pipe, maximum setting -0.075" w.c.

Electrical Installation

These instructions do not supersede local codes. Local authorities having jurisdiction should be consulted before installation.

Wiring

- Your unit is completely prewired.
- See wiring diagram for details

Thermostats Wiring

- Install the two thermostats beside each other and follow the wiring diagram for proper connection. (For EW models)

Operator fan and limit controls

FOR EW MODELS ONLY:

- The two combination controls must be installed in the warm air plenum with the bracket supplied. (See fig. #1 and fig. #4)
- The control on the right is used as a fan control only and the setting must be 100° F.
- The control on the left is used as a limit control set at 160° F.

FOR W-80 & AO-80 MODELS:

- Only one (1) control is required, the fan side is set at 100° F and the right side at 160° F.

  CAUTION: The controls settings are factory calibrated and should not be altered for any reason.
- A minimum of 6" clearance above the warm air plenum shoulb be maintained for a distance of 6 feet. (See fig. #3).
- The use of large warm air duct will increase the heat distribution during power failure.
- The external static pressure should be .20 inches w.c.
- If the furnace is in a confined space, combustion air must be introduced in the area.
- The unit filter rack must be installed on the left or right side of the unit.
- Minimum installation clearance from combustion material:
  - Front of furnace 48"
  - Sides 24"
  - Return air plenum 2"
  - Flue pipe 18"
  - Behind the furnace 18"

5. OPERATION

- The wood thermostat should be set 5° F (3° C) higher than the other if you want to use the wood furnace. When the wood fire dies down, the electrical or oil furnace will start automatically should the temperature drop 5° F (3° C) below the wood thermostat setting.

To start your wood fire follow these procedures:

- Crumble paper and place in chamber, place dry kindling wood on top of paper add a small quantity of larger wood on top of kindling ignite with a match and close door.
- Damper must be opened, raise thermostat if necessary.
- Small intense fire is preferable to a large smouldering one to reduce the amount of creosote.
- Adjust flue draft control not higher than -.075 in. w.c. A higher setting will cause the fire to burn out of control.

Procedures for control operations

- Verify if combustion air damper opens by raising the wood thermostat.
- Make sure that the damper close properly when you lower the wood thermostat.
- **For EW models only:** To verify the operation of the electric thermostat it must be raised above the wood thermostat by 5° F (3° C). The first element will go on plus the medium speed of the blower then a few seconds later the second element will go on. (If you are using a two stage thermostat the third and fourth element together with the high speed on the blower will come only when the setting of the second stage is reached). The third and fourth elements plus the high speed of the blower will immediately come on a few seconds later.
- In normal operation, when the wood thermostat is satisfied, the damper will close until the wood thermostat calls for heat.
- When the wood in the heat exchanger is completely burnt, the electric or oil thermostat will automatically start the elements when it reaches its temperature setting.

6. EXTENDED POWER FAILURE

- During a power failure, it is recommended that the operator stays in the area of the furnace.
- Do not adjust the manual air intake.
- Refuel frequently with a small load. It should never exceed ½ the full load.
- Never prop up or tie draft damper.
- Remove blower access panel and air filters.
- To prevent injury do not allow anyone who is unfamiliar with the operation of furnace to attend it.

7. SPECIAL PROCEDURES (Extreme fire due to improper operation)

- Disconnect damper chain by unhooking at damper and shut the air intake.
- Do not shut off power.
- Open barometric damper.

8. CHIMNEY FIRES OR RUNAWAY FIRES

In the event that you should experience an uncontrolled (runaway) fire in the furnace smoke pipe (chimney connector) or chimney, do the following immediately:

- Close all doors, dampers, air shutters, etc. on the furnace. This will starve the fire and cause it to die.
- Ensure that the barometric damper in the smoke pipe is closed when there is a fire (in the chimney).
- Ensure that the barometric damper in the smoke pipe is open fully for runaway fire (in the furnace).
- If the fire is brought under control without any serious damage done to the building and the furnace appears to be operational, check it over thoroughly before putting it back into service.
- Carefully examine the furnace damper, control, smoke pipe (chimney connector), chimney from top to bottom.

By following these basic steps you will bring the fire under control. The time it takes to bring it under control depends upon the amount of fuel in the furnace and the rate at which it is burning at the time it is detected.

9. SMOKE PIPE INSPECTION

- The smoke pipe should be inspected on a regular basis during the heating season.
- Whenever possible, the smoke pipe should be dismantled and cleaned out.
- The smoke pipe should be carefully examined for defects such as corrosive seams coming apart, etc.
- If any defects are noticed, the pipe should be replaced.

10. INSTRUCTIONS FOR CLEANING THE FURNACE

Do not start to clean until fire is completely out.

- Using scraper, scrape inside walls and bottom of baffle and sides.
- Using scraper, scrape inside flue walls and top of baffle.
- Remove smoke pipe from flue outlet.
- Remove the creosote.
- Remove baffle (see fig. #2)

11. MAINTENANCE

- In order for a solid-fuel heating system to operate efficiently and safely the entire system must be properly maintained. This means that the furnace chimney connectors and joints and the chimney flue must be in proper working order and clean.
- The air filter must be changed regularly. Same size and type must be used.

12. CREOSOTE — FORMATION AND REMOVAL

When wood is burned slowly, it produces acetic and pyroligneous acids, which combine with expelled moisture to form creosote vapors, which condense in the relatively cool chimney flue of a slow-burning fire. As a result, creosote residue accumulates on the flue lining and seeps into any mortar joints that are not tight and into any other exposed cracks. When ignited this creosote makes an extremely hot fire.

It is far better, of course, to prevent accumulations of creosote by maintaining a briskly burning fire with dry, well seasoned wood. If creosote does accumulate it may be removed by the usual and oldest method — human energy and a proper chimney sweep's brush; it is not good enough to lower a weight down the chimney, nor to pull a few branches up and down.

Chemical chimney cleaners are available. Opinions on their effectiveness vary, but when used regularly and as directed they work and do not damage the chimney.

13. RECOMMEMDED FUEL

Seasoned hardwood and softwods both make excellent fuels with hardwoods being longer burning. Seasoned wood is wood which is cut and split in the early spring for use during the next winter.

Fuel should be stacked in a dry location, preferably under a protective cover to reduce moisture accumulation. Sufficient fuel for immediate use may be stacked in the vicinity of the furnace, but under no circumstances should it be stored within the furnace installation clearances, or within the space required for charging and ash removal.

14. CHIMNEY MAINTENANCE

- One of the most efficient methods to clean a chimney is to lower a stiff brush (chimney brush) tied to a heavy weight down the chimney on a rope. Work the brush up and down the chimney to scrape the accumulated creosote and soot off the chimney walls. Remove the residue from the clean out at the base of the chimney.
- The chimney must be verified on a regular basis and when creosote is noticed it must be removed as per above. Be aware that weekly cleanings may be necessary in milder weather even though monthly cleanings may be enough in the coldest months.

ONLY FOR THE AO-80 MODEL

15. WARNING

- DO NOT USE A DIVIDER IN THE WARM AIR PLENUM.
- DO NOT CHANGE BLOWER IN THE EXISTING OIL FIRED FURNACE.
- BEFORE INSTALLING AN ADD-ON UNIT ONTO YOUR FURNACE, DUCTS AND CHIMNEY SHOULD BE IN GOOD CONDITIONS.
- A VERIFICATION OF THE AIR FLOW THROUGH THE EXISTING FURNACE SHALL BE MADE.

16. INSTRUCTIONS FOR MEASURING AIR FLOW IN THE EXISTING SYSTEM

(BEFORE ADD-ON UNIT IS INSTALLED)

AIR TEMPERATURE RISE METHOD

- Two (2) thermometers (range 0° F to 250° F) are required. Drill a hole in the warm air plenum and insert one of the thermometers. Same procedure for the return air plenum. Turn on the thermostat well above the room temperature so that the existing oil furnace will not stop during the test. Let the unit run during 20 to 30 minutes then take the reading on both thermometers. The reading on the return air plenum should be approximately the same as the house temperature. The reading of the warm air plenum shoud be approximately 85° F ± 5° F. higher than the return air plenum.

NOTE: Many thermometers have a lenghtly lag causing them to be slow in levelling off. Adequate time should be given for them to stabilize.

- When the add-on is installed, the same test procedure must be done and the same temperature should be maintained.
- You might have to change the blower pulley or the motor pulley or both. It may also be necessary to change the motor if the motor amperage is over the name place rating.
- By changing the blower pulley or motor pulley, or both, the temperature rise through the oil furnace can be increased or decreased. Reducing the blower speed will increase the temperature rise and increasing the blower speed will reduce the temperature rise through the oil unit. You must change the blower speed to maintain a temperature rise of approximately 85° F.

These steps are necessary to make certain that the air temperature rise is correct both before and after the wood add-on furnace is installed.

- To get the air flow required through the furnace and to keep the blower noise at as low a level as possible, it may be necessary to consider relieving some of the pressure in the duct system. This can be done by adding more return or warm air outlets or both especially if locations can be found to improve the overall comfort satisfaction.
- The equipment shall be installed in accordance with the manufacturer's instructions and in a manner acceptable to the regulatory authority by mechanics experienced in such services. When required by the regulatory authority, such mechanics shall be licensed to perform this service.
- The installation shall comply with the applicable requirements of CSA Standard B365, Installation Code for Solid Fuel Burning Appliances and Equipment, and if changes are made to the installation of the existing heating system, this shall comply with CSA Standard B139, Installation Code of Oil Burning Equipment.

WARRANTY

The undersigned,

HEREBY WARRANTS

the warm air furnace to be free of defects in materials or workmanship when installed and operated according to our instructions.

We will repair or replace without cost to you, F.O.B. our factory for a period of one (1) year from date of installation, any part or portion which our examination shall disclose to be defective in materials or workmanship (Labour not included).

The conditions of this warranty are.

1. The furnace must have been installed by a competent heating contractor.
2. The furnace must be installed according to our instructions and local codes.
3. The heating system be installed in accordance with the recommendations of the National Warm Air Heating and Air Conditioning Association.
4. The furnace not been moved from its original installation.
5. Protection from flooding and excessive moisture have been provided.
6. Air from a summer cooling unit must not have been circulated over the heat exchanger of the furnace.

We further garantee the heat exchanger against burning out for a period of 10 years from the date of installation, subject to the following terms and conditions:

- During the first year of its installation, we will, upon presentation of proper evidence replace without charge and F.O.B. our factory the defective heat exchanger.
- From the 2nd to 10th year of this warranty, any replacement will be subject to a prorata (current retail price) charge based upon the number of years that this warranty has been in force.

No representative of POWRMATIC OF CANADA LTD., nor any of its distributors or dealers had any authority to alter in any manner the terms of this warranty.

POWRMATIC OF CANADA LTD

709 Léveille Street, Terrebonne, Quebec J6W 1Z9

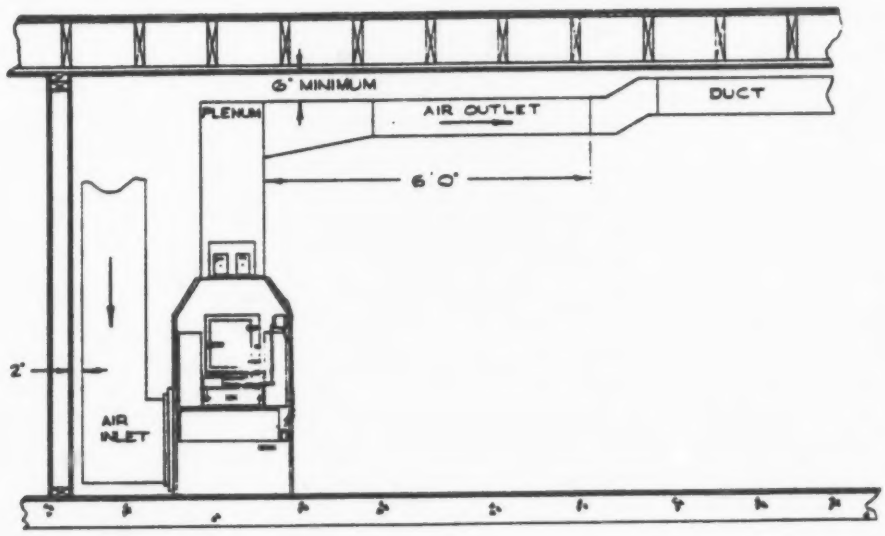


FIG 3

powrmatic

MINIMUM CLEARANCE FOR INSTALLATION

DATE JUNE, 30, 82

SCALE 1" = 1'0"

D HUARD

EW

2700104

WARNING : WARM AIR PLENUM AND FIRST 6 FT OF ALL DUCTS AND ROUND PIPE EXTENDING FROM THE PLENUM SHALL HAVE A CLEARANCE OF NOT LESS THAN 6" INCHES FROM COMBUSTIBLE MATERIAL.

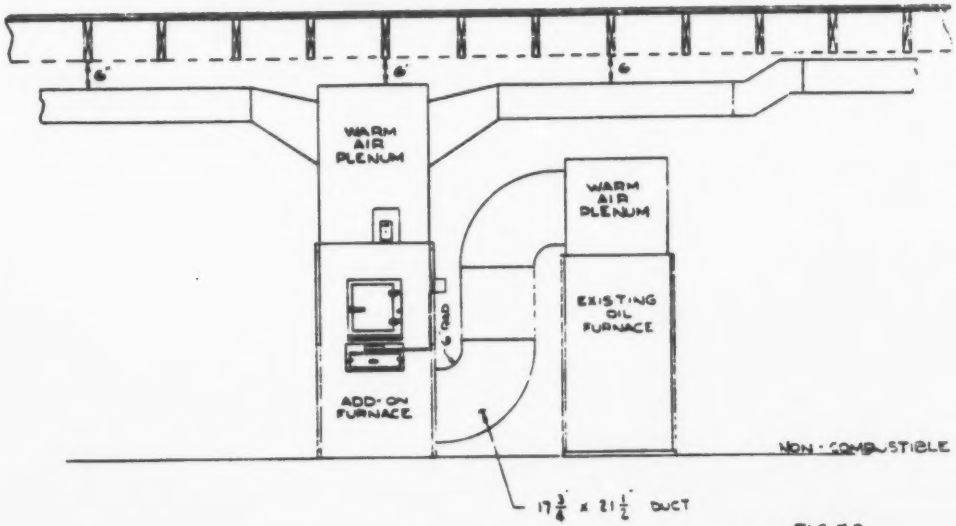


FIG. # 3

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CLEARANCE FOR INSTALLATION

4.4 WOOD BOILERS

Boilers include heating appliances that supply hot water or steam for distribution to heat radiator units located throughout a building. Cooled water from the radiators is returned to the boiler for reheating. Two types of wood boilers are considered for the Rae Edzo community - combination wood/oil boilers, and wood only boilers. Wood boilers are commercially available in a broad variety of sizes, designs and wood fuel types. Certain designs are optimized for log fuel, for sawdust and sander dust, or for wood chips. Units range in size typically from 100,000 BTU/hr. to 30,000,000 BTU/hr. The larger units are frequently found at pulpmills, lumber mills, etc. Many units are equipped with automated wood fuel stoking systems. Vendors generally offer to install oil burners on the boilers to create a combination wood/oil boiler plant.

Examples of wood boilers of sizes suitable to replace the existing boilers encountered in the community are presented in the attached product sheets.

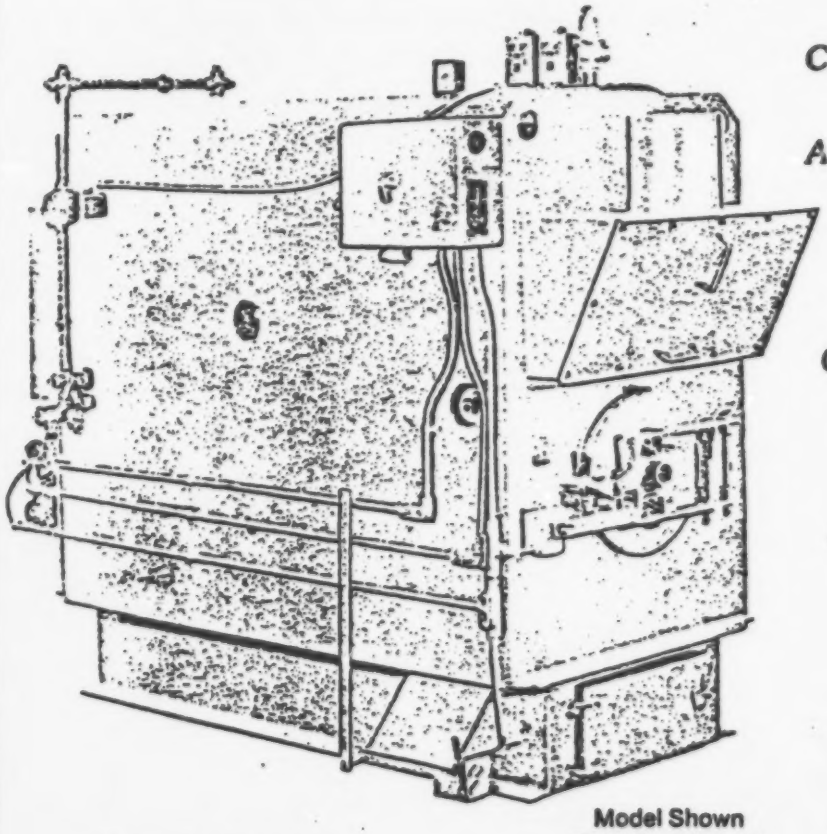
Syncro

COMBINATION OIL AND SOLID FUEL

DUAL-PAK SERIES II

Boilers

Boilers built in Canada by Robt. Bell Industries Ltd., an All-Canadian Company with over 80 years Boiler Building experience



Model Shown
DUK-24-OW-30W
Standard Finish

ALSO AVAILABLE AS SOLID FUEL ONLY UNITS

Boilers
Designed
to
Combat High Energy Costs

Avoid Problems Caused By
Fuel Shortages
or Power Failures

Conserve Your Country's
Energy Supplies
with
Automatic Changeover
Between Fuels
for
Low Pressure Steam
or Hot Water Heating

BULLETIN No 102-81

Robert Bell Industries Limited

TELEX 069-55305 — SEAFORTH, ONTARIO — 519-527-0600
P.O. BOX 70 N0K 1W0

Engineered to Last

The Dual-Pak Series boilers are a 2 Pass firebox design constructed to the ASME low pressure boiler code and the requirements of the provinces of Canada.

Two and one-half inch diameter boiler tubes are used allowing for low draft loss to facilitate operation with natural draft for solid fuel fires. All boiler tubes are rolled, beaded and rerolled providing for maximum in seal and strength. Boilers are designed for oil output rated at 6 or more square feet of heating surface per boiler H.P. All units are covered with fiberglas insulation and steel jacket with a Hi-Temp enamel finish. Ample openings are provided to all firing and internal surfaces for cleaning and inspection. Gas tight front and rear smoke boxes are constructed of 10 ga. steel to provide for maximum length of troublefree service. The rear somebox is insulated to prevent heat loss as well as offering protection to the smokebox.

Combustion

These units do not use so called "air tight" combustion areas and long burns since these features are the paramount culprits producing creosote. An extra large furnace volume coupled with a high temperature dry refractory lined firebox maintains high temperatures in the combustion zone enabling complete combustion. This is especially advantageous for burning fuels of higher moisture content. Cast iron grates enhance the unit's versatility in selection of solid fuels. Units are designed with an extra large grate area to ensure its rated output on solid fuel firing. Combination units come equipped with forced draft burners for the economic burning of light oil. Oil and wood are fired in the same combustion zone to facilitate ignition of most solid fuels. An automatic under the fire damper ensures that an adequate supply of combustion air is provided to facilitate complete combustion of solid fuels.

Fully Automatic

All Dual-Pak Series packaged firebox boilers are fully automatic. Since oil and wood are fired in the same combustion zone, oil may be used to ignite most solid fuels, avoiding the tedious procedure of kindling solid fuel fires. The control system governs four separate operations controlled by a 3-way selector switch on the control panel and a manual timer.

OPERATING MODES

1. OIL ONLY AS FUEL

2. WOOD OR SOLID FUELS ONLY

3. AUTOMATIC: A constant temperature is maintained at all times. Oil automatically takes over when solid fuels burn out.

4. OIL IGNITION DELAY: Locks out oil burner on occasions when ample solid fuel has been added but fire is not fully established — saves additional oil.

The automatic below the fire damper opens and closes as the need for more heat arises when solid fuel firing. As a safety precaution the auto damper closes prior to any times the oil burner operates.

A fire door safety switch is provided to shut the oil burner off when the fire door is opened.

EASY TO OPERATE

EASY TO SERVICE

EASY TO CLEAN

SAVE WITH THE DUAL-PAK SERIES FIREBOX BOILERS

STANDARD EQUIPMENT

1. 2 Pass firebox boiler constructed to the ASME low pressure boiler code and the requirements of the provinces of Canada.
2. 2½" boiler tubes, rolled, beaded and rerolled providing maximum seal and strength. Allows for low draft loss to facilitate operation with natural draft.
3. Oil ouput rated at 6 or more sq. ft. of heating surface per boiler H.P.
4. Covered with fibreglass insulation (R-valve of 4 per inch) and steel jacket with Hi-Temp enamel finish.
5. Gas-tight front smoke box with removable door.
6. Removable insulated gas-tight rear smokebox.
7. Dry refractory lined firebox to maintain high temperature combustion zone enhancing complete burning-especially advantageous for fuels of higher moisture content.
8. Extremely large grate area for rated output on solid fuels.
9. Fully automatic.
10. Ample openings to all firing and internal surfaces for cleaning & inspection.
11. Large furnace volume to aid in complete combustion of solid fuels.
12. Cast iron grates.
13. Oil ignition delay timer.
14. Large firedoor with positive seal.
15. Large ash door to facilitate ash removal.
16. Automatic below the fire damper.
17. Firedoor safety switch.
18. Manual timer - oil burner 5 min. to 2 hours for solid fuel ignition.
19. Flue brush and rod.
20. Overfire air system.

STANDARD TRIM ON STEAM UNITS

1. Safety Valve(s).
2. MM-42 low water cutoff and pump control.

STANDARD STEAM TRIM (continued)

3. Waterglass set.
4. Watts N-101S auxilliary low water cutoff control c/w blowdown valve.
5. Steam pressure gauge.
6. Gauge cocks.
7. Syphon.
8. Pressuretrol - operating oil.
9. Pressuretrol - operating solid fuel.
10. Pressuretrol - hi-limit both fuels.
11. Pressuretrol - hi-fire control for 2 stage oil.
12. Water column blowdown valve for MM-42.
13. Boiler blowdown and drain valve (2).

STANDARD TRIM ON HOT WATER UNITS

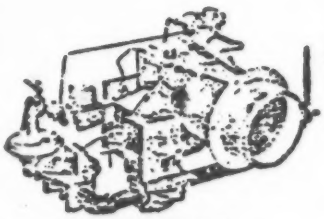
1. Relief valve.
2. Tridicator for pressure and temperature.
3. Watts N-50D low water cutoff.
4. Dual aquastat providing for solid fuel operating control and hi-limit.
5. Single aquastat providing for oil operating control and damper closure on oil firing.
6. Single aquastat - hi-fire control for 2 stage oil.
7. Blowdown valve for low water cutoff.
8. Boiler drain valve (2).

OPTIONAL EQUIPMENT

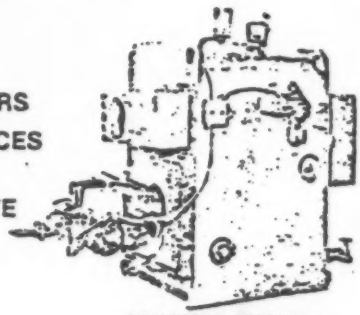
1. Opening for instantaneous or tank type coil heaters.
2. Automatic Stack Damper.
3. Elliptical Flue Brush.
4. Removable Base.
5. Draft inducer power outlet wired to operating circuit plus manual override switch.
6. Extra overfire air openings.
7. Other models available for sawdust, chips and coal only.
8. Induced draft fan system.
9. I.D. fan bypass damper.
10. Fan assist for overfire air.

Your headquarters for:
Custom Boilers and Pressure Vessels

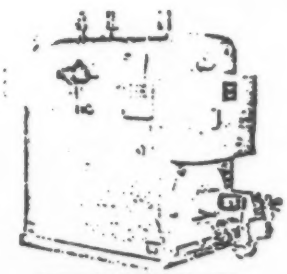
HIGH AND LOW PRESSURE BOILERS
SCOTCH, VERTICAL AND FIREBOX
HOT WATER HEATING BOILERS
COMBINATION OIL AND SOLID FUEL BOILERS
COMBINATION OIL AND SOLID FUEL FURNACES
HIGH AND LOW PRESSURE BOILERS FOR AUTOMATICALLY FIRED WOOD WASTE
PORTABLE BOILERS
OIL BURNERS
GAS BURNERS
CONDENSATE UNITS
CONDENSATE RETURN PUMPS
BLOWDOWN TANKS
AIR RECEIVERS
BOILER AND BURNER CONTROLS
SOLID FUEL ONLY BOILERS
SOLID FUEL ONLY FURNACES
GRAVITY FLOW FURNACES



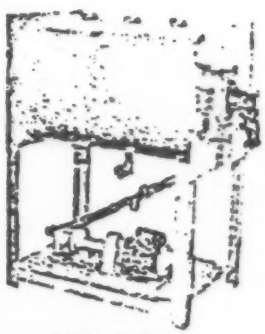
POWER GAS BURNERS
212,000 TO 7,400,000 BTU/HR INPUT



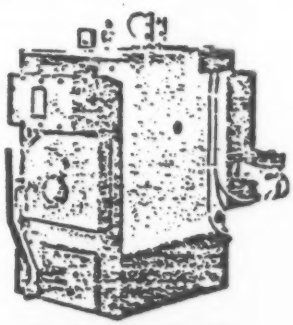
3-PASS COMPACT BOILERS
GAS FIRED OR OIL FIRED
5 H.P. TO 15 H.P.



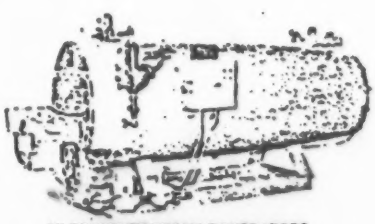
COMPACT SERIES BOILERS
3-PASS GAS FIRED OR OIL FIRED
10 H.P. TO 600 H.P.



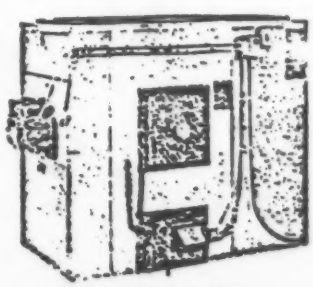
CONDENSATE UNITS
10 H.P. TO 600 H.P.
15 P.S.I.G. TO 200 P.S.I.G.



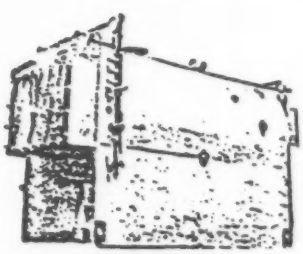
DUAL-PAK 3.5 COMBINATION
SOLID FUEL/OIL BOILERS
TO 125,000 BTU/HR OUTPUT



HI-PRESSURE STEAM GENERATORS
GAS FIRED OR OIL FIRED
3 H.P. TO 600 H.P.

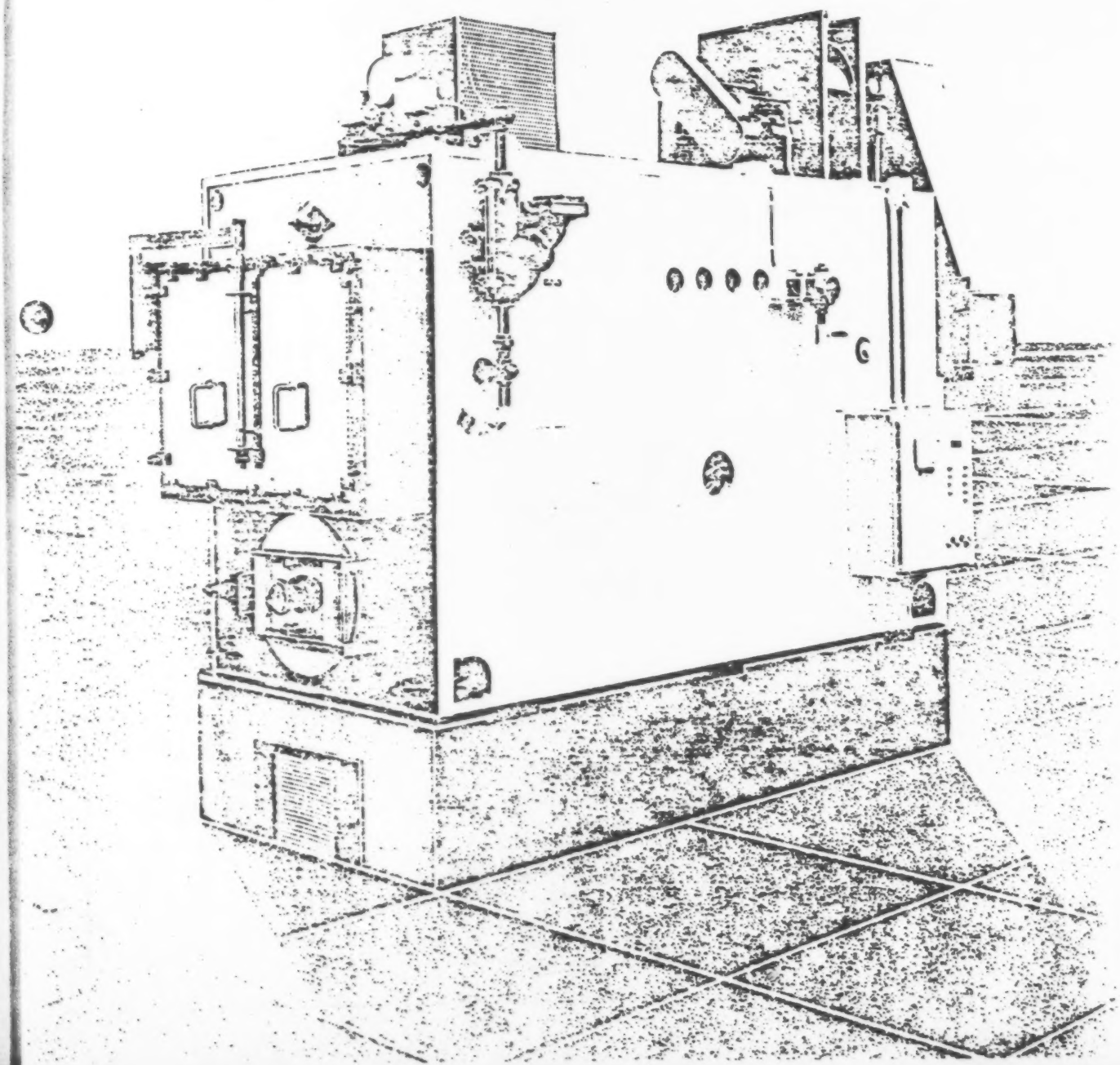


DUAL-AIRE COMBINATION
SOLID FUEL/OIL FURNACES
150,000 TO 500,000 BTU/HR OUTPUT



AUTOMATIC WOOD WASTE
FIRED FIREBOX BOILERS
HIGH OR LOW PRESSURE
UP TO 600 H.P.

Our new packaged boiler system can save you time, space, and money.



It's a perfect boiler for small

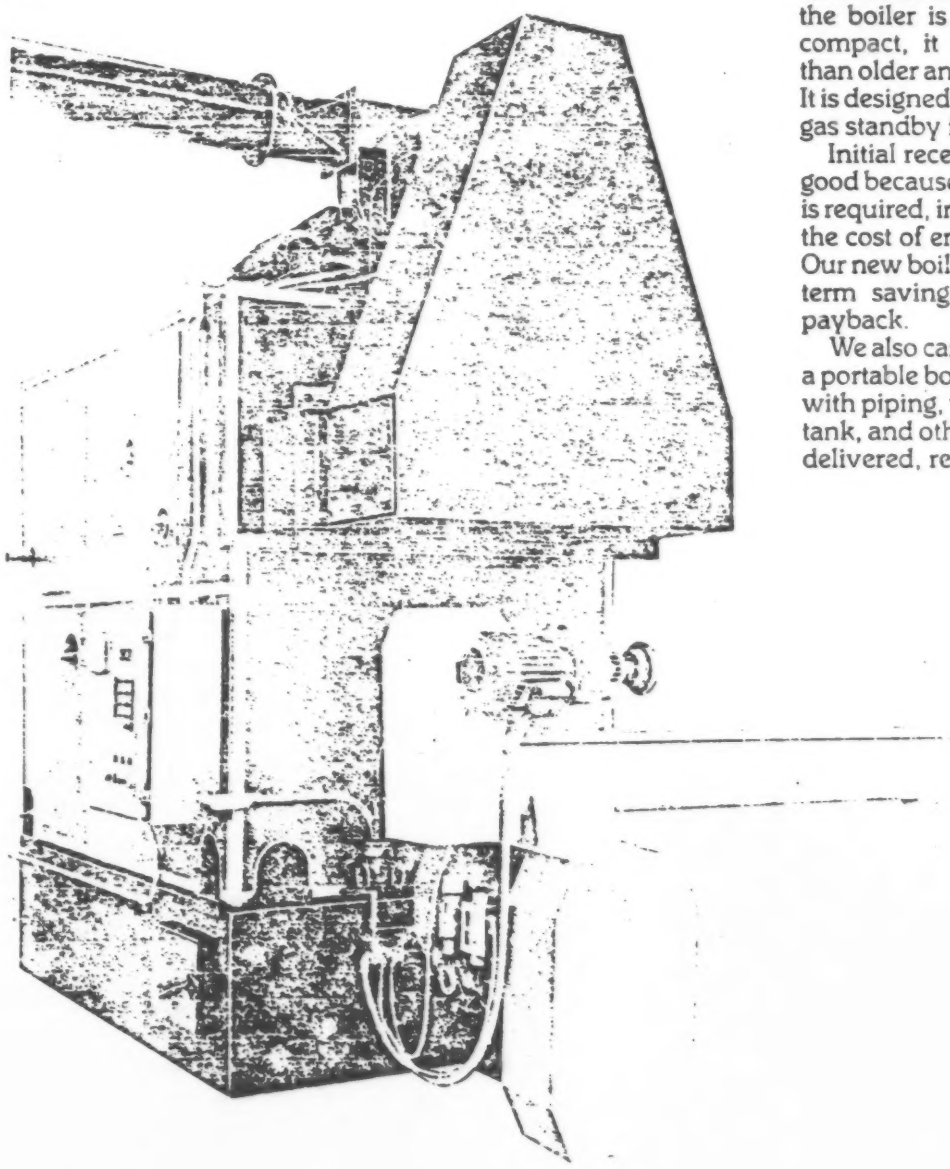
Our newest introduction in the woodwaste and energy industries is a compact, packaged woodfired boiler that will require minimum installation time in your plant.

It is fully automatic and is factory-assembled so that when it is delivered to you, it is ready to install. We pre-plumb the boiler for hot water, low pressure steam, or high pressure steam. The electric control panel (including all starters, relays, and timers) is pre-wired.

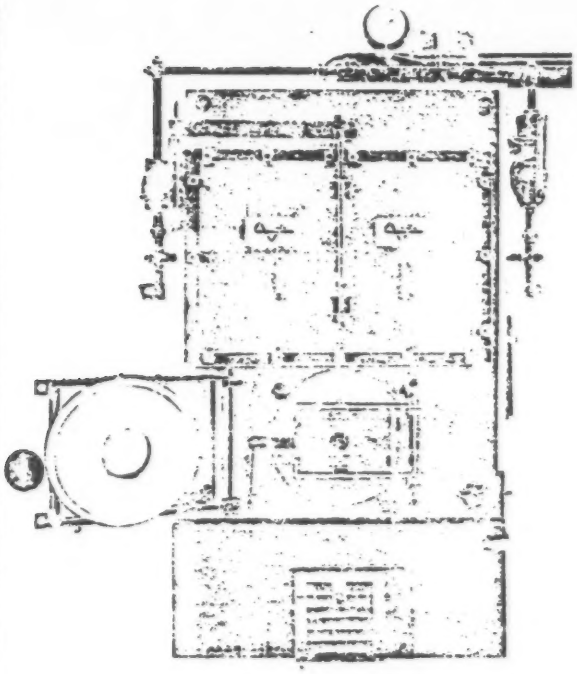
With a wide range of horsepower, the boiler is ASME constructed and EPA accepted. Because the boiler is pre-assembled and compact, it requires less space than older and larger type boilers. It is designed to use optional oil or gas standby fuels.

Initial reception has been very good because minimal field work is required, installation is fast, and the cost of energy is economical. Our new boiler will give you long-term savings and a short-term payback.

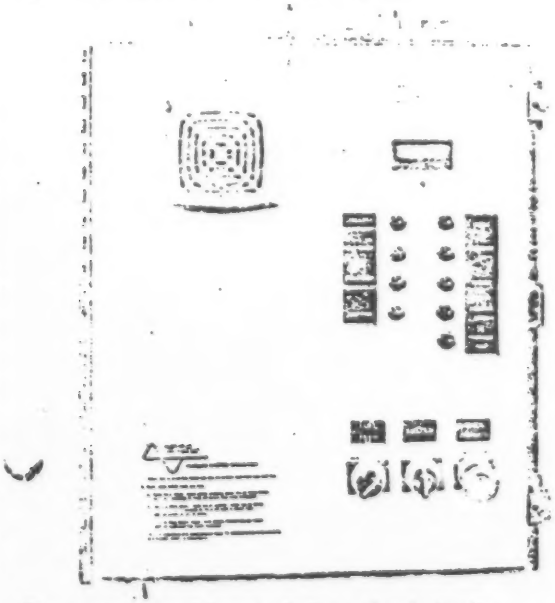
We also can supply the boiler in a portable boiler house, complete with piping, wiring, a condensate tank, and other features. It comes delivered, ready to run.



nd medium size companies.



Optional swing out door for standby oil/gas burner



Electric control panel, featuring built-in safety devices for automatic operation

Woodwaste Evaluation Table

Moisture % (Wet)	Recoverable BTU/Lb.	Lbs./Hr. of Wood Per 10 HP Output	Lbs. of Wood Replace 1 Gal. Oil	Lbs. of Wood Replace 1 MCF Nat. Gas
10	6,060	55	18.5	140
20	5,250	64	21.3	162
30	4,400	76	25.4	193
40	3,570	94	31.3	238
50	2,770	121	40.4	307

Other features that make our packaged boiler a good buy for you

- Rotary air lock prevents burnback
- Stoker screw augers woodwaste on demand from boiler
- Non-electric sprinkler valve gives you extra protection
- Combustion air nozzles help provide for complete and clean combustion
- Access doors make cleaning ash pit and flues easy
- Induced draft fan gives controlled draft, without requirement for large natural draft stack
- Sensors for temperature or pressure turn woodfired system on and off to meet your demand

Our fully-automatic, ready-to-install packaged boiler is the most economical woodfired energy system we manufacture. It is a good, reliable, well-built piece of equipment that is priced so that even the smallest of plants can afford it.

We would like to talk to you about how our newest boiler can save you time, space, and money. Write or call us about your plant and its requirements.

NORTHFAB SYSTEMS, INC.

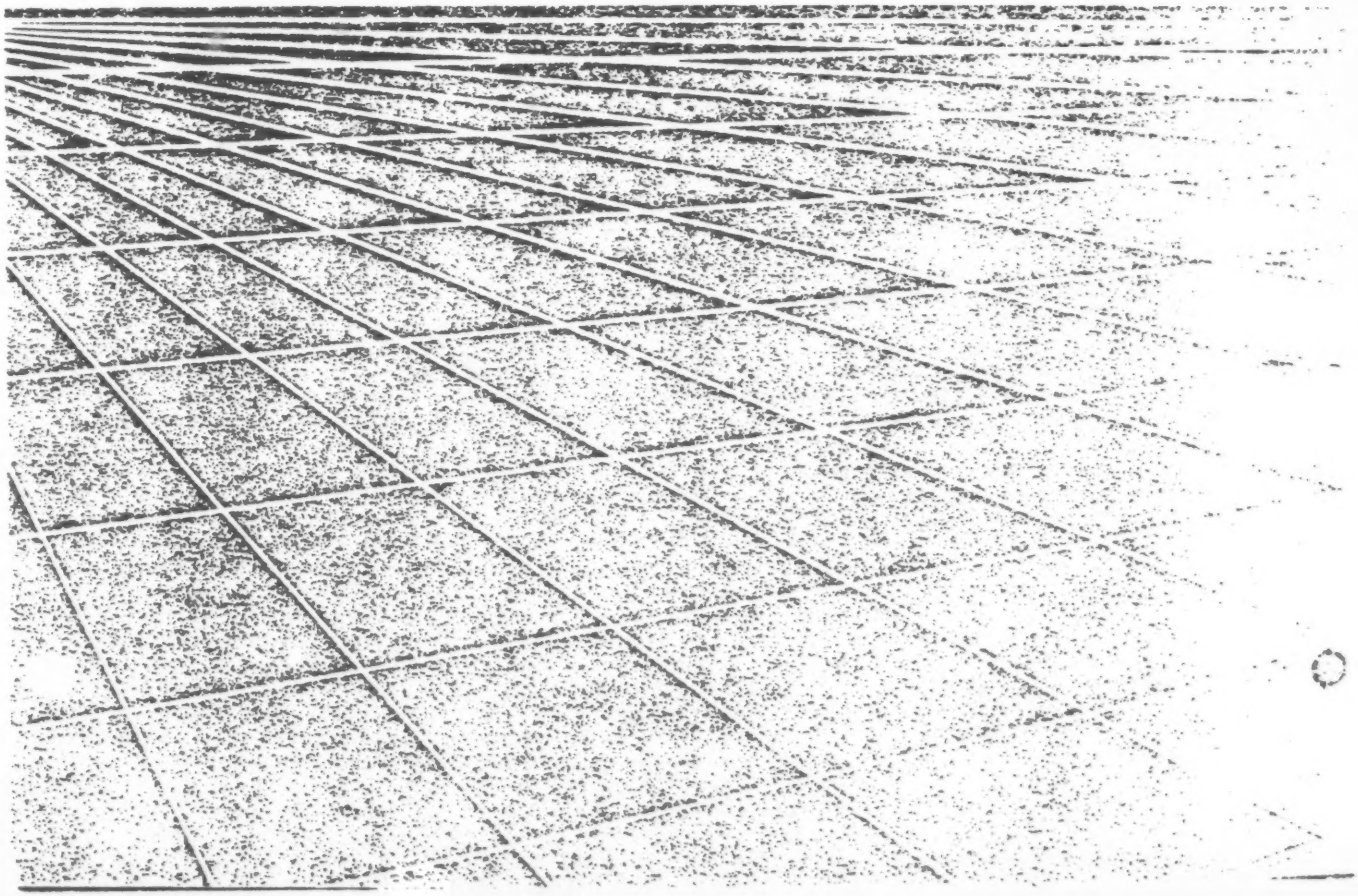
P.O. Box 429
Thomasville, NC 27361
(919) 889-5599

BOX 429 THOMASVILLE, N.C. USA 611

NORTHFAB
SYSTEMS, INC.

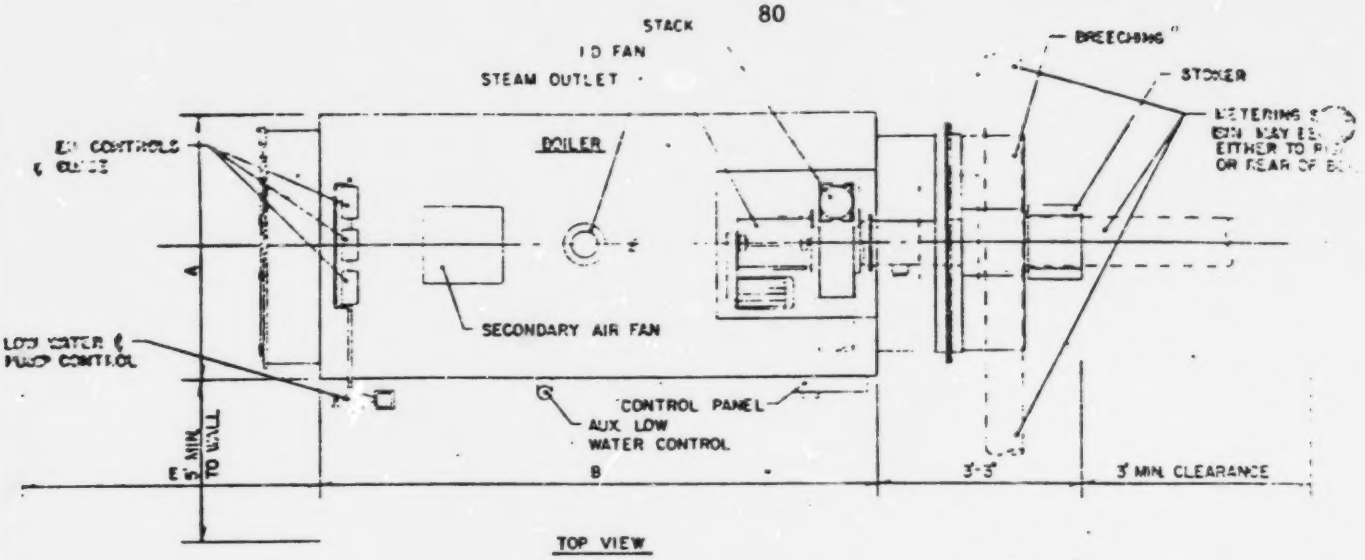
P.O. Box 429
Thomasville, NC 27361
(919) 889-5599

PRINTED IN U.S.A.

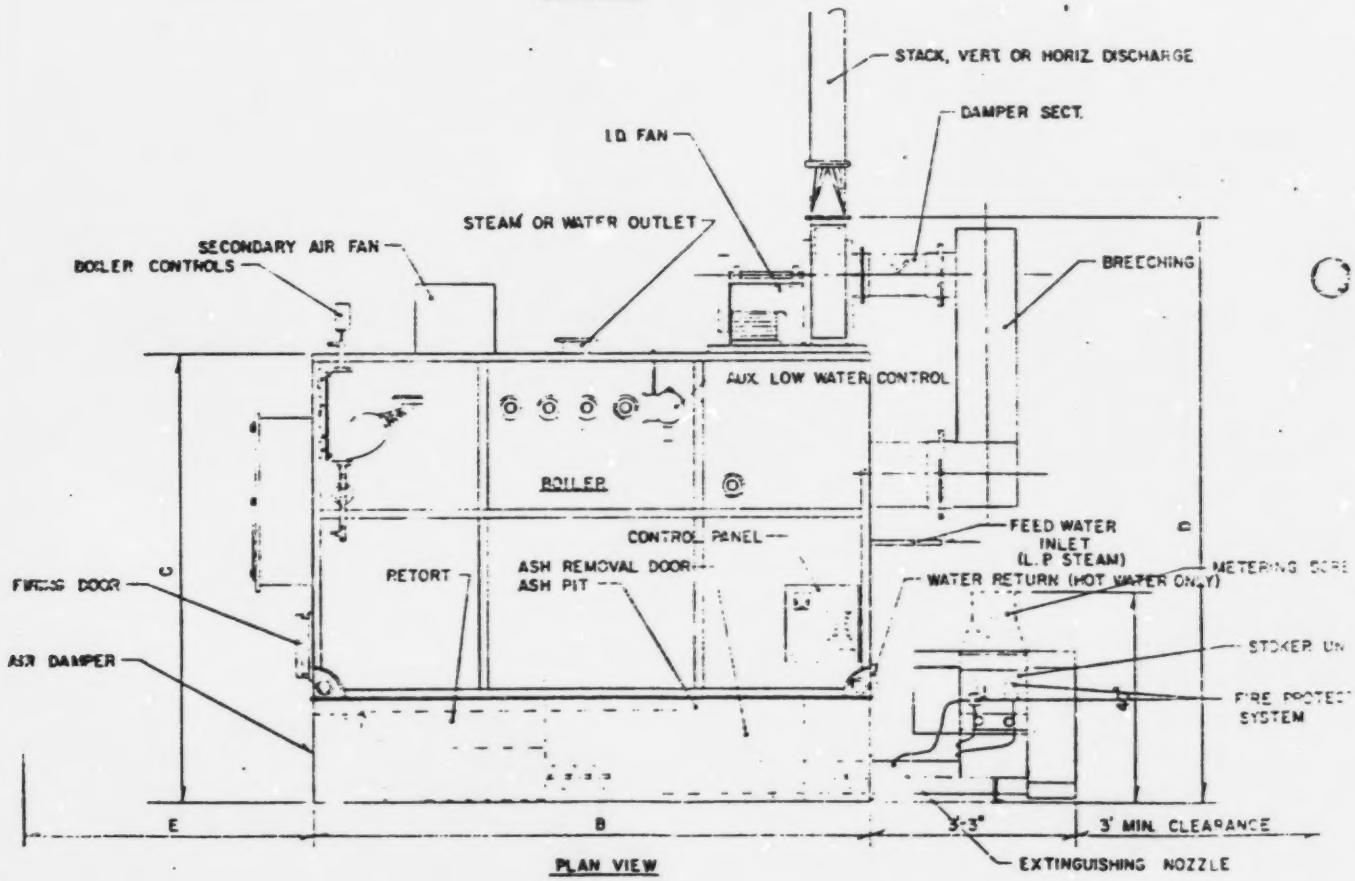


NORTHFAB SYSTEMS INC.

80



TOP VIEW



PLAN VIEW

DIMENSIONS							
HORSEPOWER		20	30	40	50	60	75
HEATING SURFACE SQ. FT.		130	200	260	325	390	480
A	BASE WIDTH	42	42	44	51	51	51
B	BASE LENGTH	57	85	81	83	99	119
C	BOILER HEIGHT	73	73	86	86	86	86
D	OVERALL HEIGHT	94	94	107	111	111	111

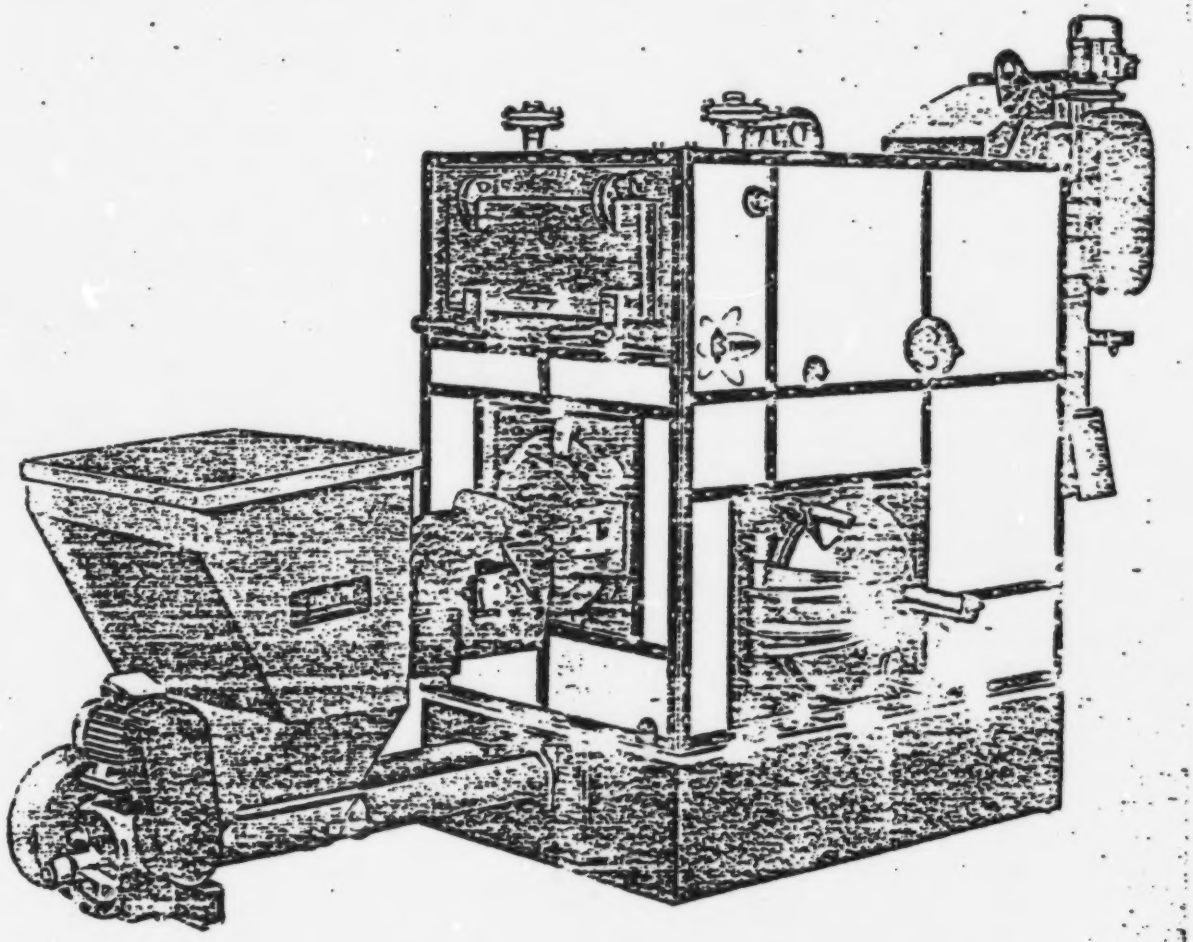
ELECTRICAL REQUIREMENTS

1-15 AMP., 1 Ø, 120 V. CONTROL CKT.
AND
2-15 AMP., 3 Ø, 208-230 V. CKTS.
OR
1-15 AMP., 3 Ø, 460-575 V. CKT.

EURO-THERM

EURO-THERM BOILERS WITH AUTOMATIC SMOKETUBE-CLEANING

PICTURE: HE-K/T 2/6-150 WITH COALSTOKER TYPE »T« (with oil- og gas standby burner)



HOT WATER- AND LOW PRESSURE STEAM BOILERS FOR COAL- AND WOOD WASTE UNDERFEED STOKERS

Agent:

Passat

PASSAT ALTERNATE ENERGY INC.

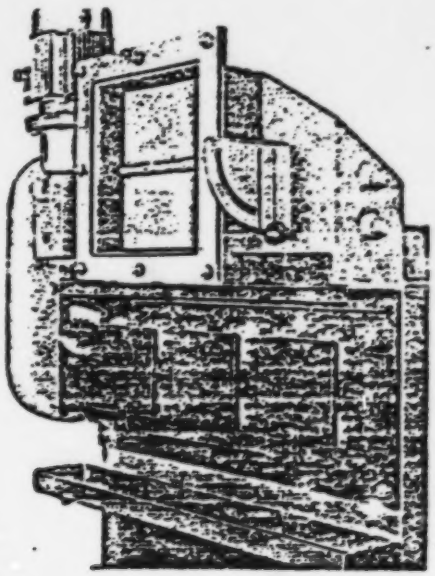
produits et systèmes
à énergie renouvelable.

TÉL.: (819) 843-[illegible]

Producer:

[illegible]

8720 RANDBAND [illegible]



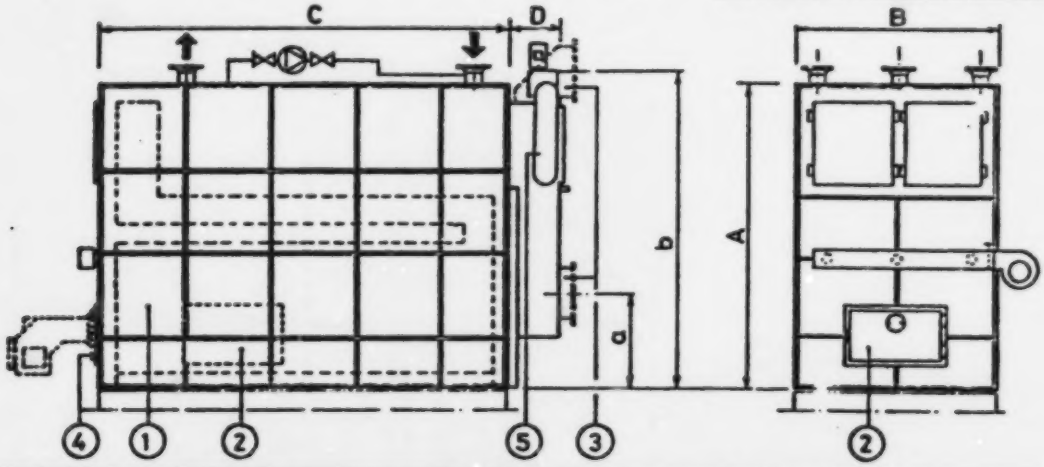
① Boiler

② De-ashing door

③ Exhaust gas outlet

④ Plate for standby-burner

⑤ Automatic cleaningsystem for smoketubes



Boiler type:	Output coal	Output wood	Water cont.	Boiler weight	Dimensions (mm)					
HE-K/T	Mcal/h	Mcal/h	m³	kg	A	B	C	D	a	b
2/4 - 125	120	100	0,54	1400	1420	730	1310	215	520	1470
2/4 - 175	160	125	0,63	1760	1420	730	1810	215	520	1470
2/6 - 150	200	160	0,65	1880	1420	930	1560	215	520	1470
2/8 - 150	250	200	0,75	2200	1420	1130	1560	215	520	1470
2/8 - 175	315	250	0,85	2460	1420	1130	1810	315	545	1495
2/10 - 175	400	315	0,96	2800	1420	1330	1810	315	570	1520
2/10 - 200	500	400	1,08	3110	1420	1330	2060	315	570	1520
4/10 - 200	650	500	2,20	4000	1970	1410	2060	315	845	2095
4/10 - 225	800	650	2,45	4400	1970	1410	2310	315	845	2095
4/12 - 225	1000	800	3,00	5350	2070	1710	2310	365	970	2220
4/14 - 225	1250	1000	3,28	5850	2070	1910	2310	365	970	2220
4/14 - 250	1500	1200	3,61	6390	2070	1910	2560	365	995	2245
4/14 - 275	1750	1400	3,94	6930	2070	1910	2810	365	1020	2470
4/16 - 300	2000	1600	4,55	8650	2270	2110	3060	365	1020	2470
4/16 - 325	2250	1800	4,72	9350	2270	2110	3310	365	1020	2470
4/16 - 350	2500	2000	4,97	10050	2270	2110	3560	365	1020	2470
6/16 - 325	2750	2200	5,92	10500	2570	2110	3310	415	1145	2795
6/16 - 350	3000	2400	6,34	11150	2570	2110	3560	415	1170	2820
8/20 - 375	3500	3000	8,20	13600	2820	2520	3810	515	1220	3070
8/20 - 415	4000	3500	9,60	14900	2820	2520	4210	515	1220	3070
8/20 - 415	4500	4000	11,40	16900	3020	2520	4210	515	1220	3270

1,0 Gcal h = 3,968 x 10⁶ BTU/h = 1,163 MW. = 1000 Mcal/h

Dimension A for low pressure steam boilers = A + 400-800 mm

SOLID FUEL Boilers

4.5 WOOD FUEL STOKERS

A common problem to the conversion of heating systems to wood burning is how to supply fuel to the wood burning appliance. Automated mechanical stokers exist for large wood boilers. The stokers are customized to handle wood chips, log fuel or dust, and withdraw fuel from a silo or bin or other storage area to feed the boiler at a rate based on heat demand. Stoking equipment is highly desirable in cases where the heating units are normally not tended on a continuous basis, as in commercial or municipal buildings.

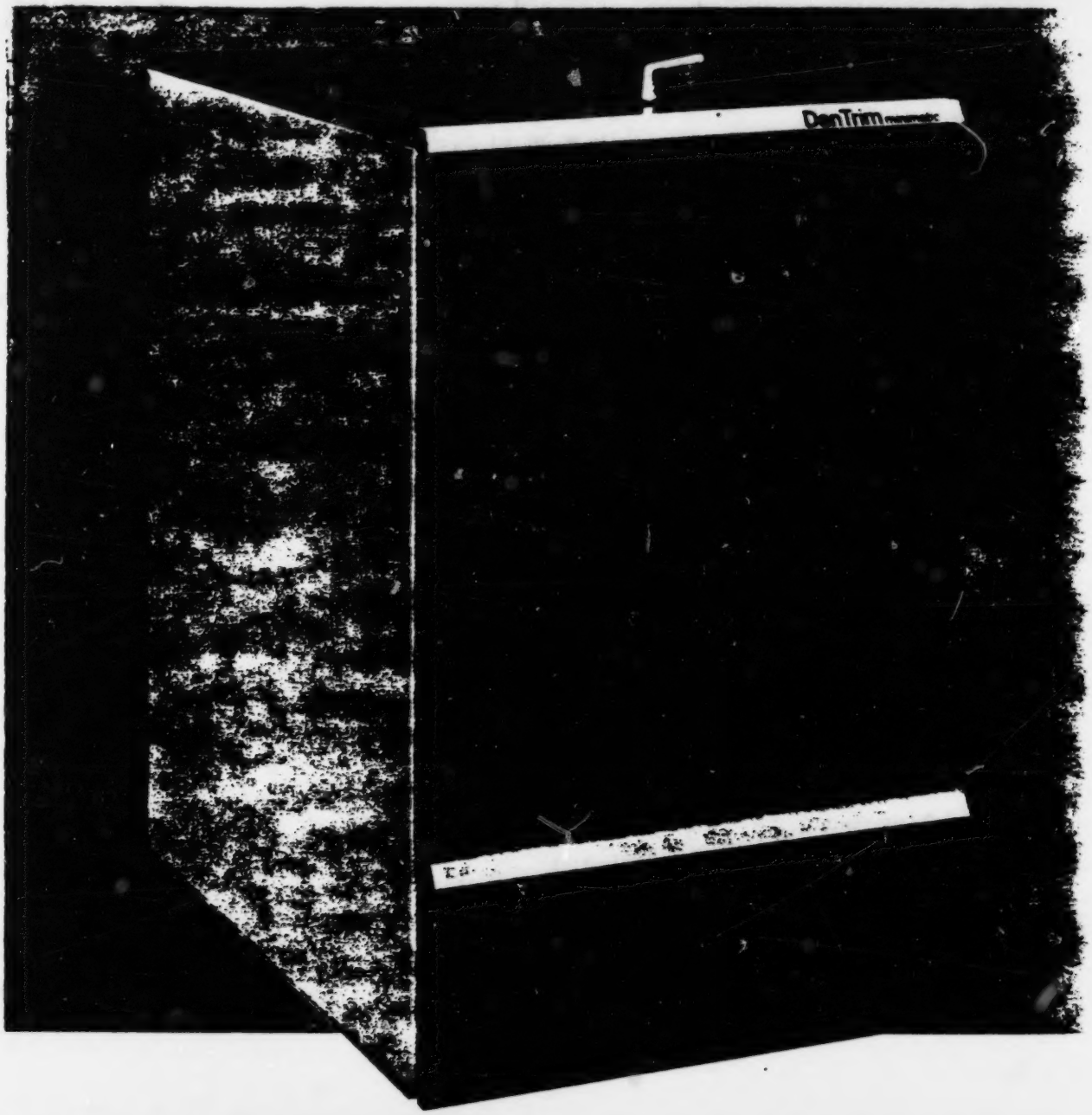
A number of domestic sized wood fuel stokers exist for attachment to residential wood furnaces. The stokers are often units that have been adapted from coal stoker designs. Satisfactory performance using pellet fuel was reported (ref. 15) for units manufactured by

- Will-Burt Co., Orrville, Ohio
- Prill Manufacturing Co., Sheridan, Wyoming
- Stokermatic Corporation, Salt Lake City, Utah

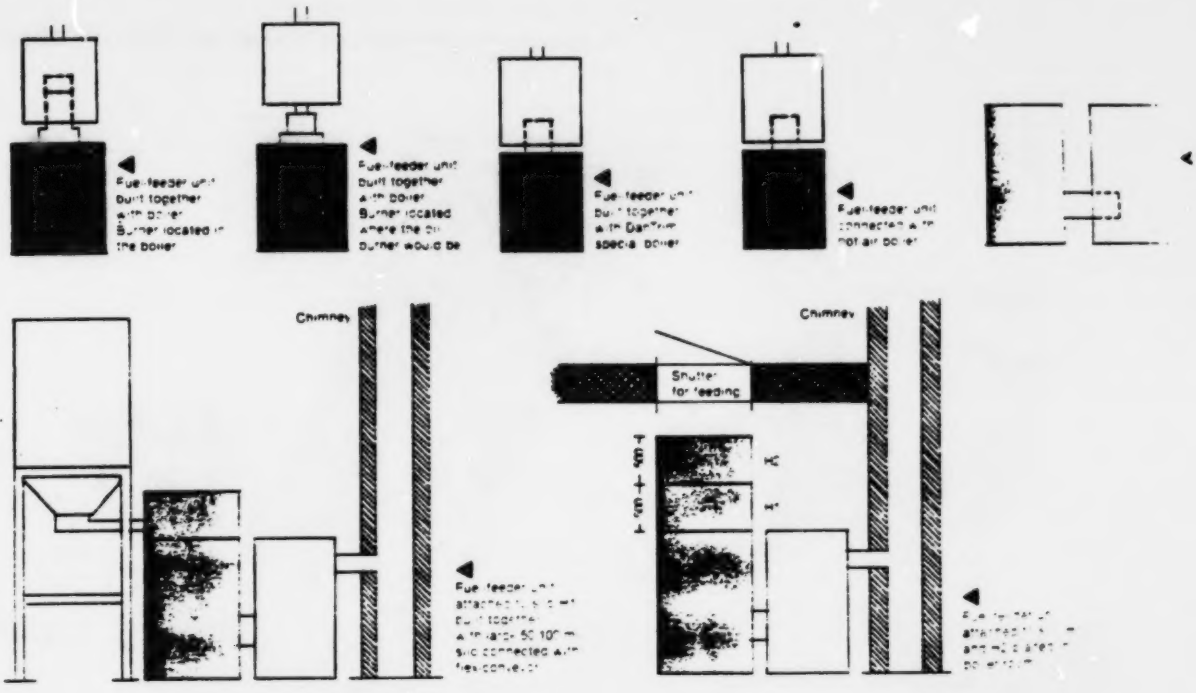
These firms indicate their units could be adapted for wood chips also.

A number of stoker preburner devices or small scale gasifiers were also reported where a hopper of wood chips or pellets is heated in an oven with the resulting combustion gases passed through a furnace for heat exchange with room air. These devices include the SVEMO OVEN (DBR Machinery), Mississauga, Ontario) and the FIREFLY (Saturn Corp., Charlottetown, P.E.I.)

84 **DanTrim minimatic**



Fyringsautomat
Automatic fuel-feeder unit
Feuerungsautomat
Chargeur
Alimentatore automatico



Minimatic fuel-feeder unit

Investment in solid fuel heating-systems, utilizing fuel which years ago would have been lost instead of expensive oil gas, is a question of economy, safety and comfort.

Minimatic fuel-feeder unit has been developed and designet in Denmark by people with more than 25 years of experience in the trade.

The fundamental principle for the construction is that heating with solid fuel must be easy, reliable and low priced, without continual fillings of fuel, without frequent ashpit-emptyings, without dirt and daily cleaning and without major maintenance.

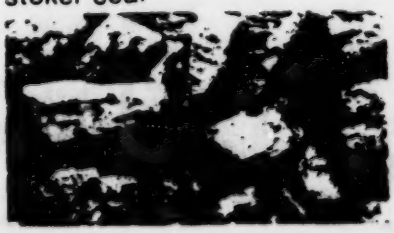
The two motors of the Minimatic fuel-feeder unit operate on only 165 watt and are running about 50% of the time in winter in summer about 15-20%, corresponding to the power consumption of a 60 watt bulb

10 good reassons for choosing DanTrim Minimatic

- Fully automatic, patent pending ashsystem, which has to be emptied only once a month
- Small mounting costs. The unit can be mounted by your lokal plumber. Telescopic legs are standard
- The fuel-feeder unit has great durability and runs with a minimum of service.
- Our factories have current quality control and tests, just as the unit has been tested, approved, fulfils the authorities demands and has been supplied with fire protection control water nozzle and a thermostat, which is T.U.V. approved
- All customers are guaranteed a third part liability insurance of the product
- Clean incineration with special, patent pending and registered design of burner
- Power consumption: 0.035 - 0.165 kW/h
- Reliable electronic control based on easily exchangeable programmable printplates.
- Unit in clean registered design in warm colours, comparatively noiseless and with finish like a refrigerator.
- Mountable in scullery, cellar or outhouse, adjustable to almost all types of boilers and connectable with stic

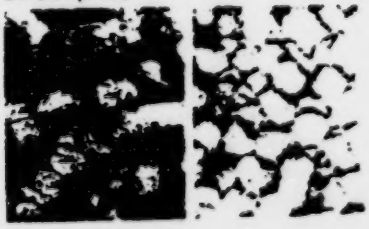
De Luxe-model is equipped with electrical ignition and photo cell control as well as automatic stop, when the fuel container is empty

stoker coal

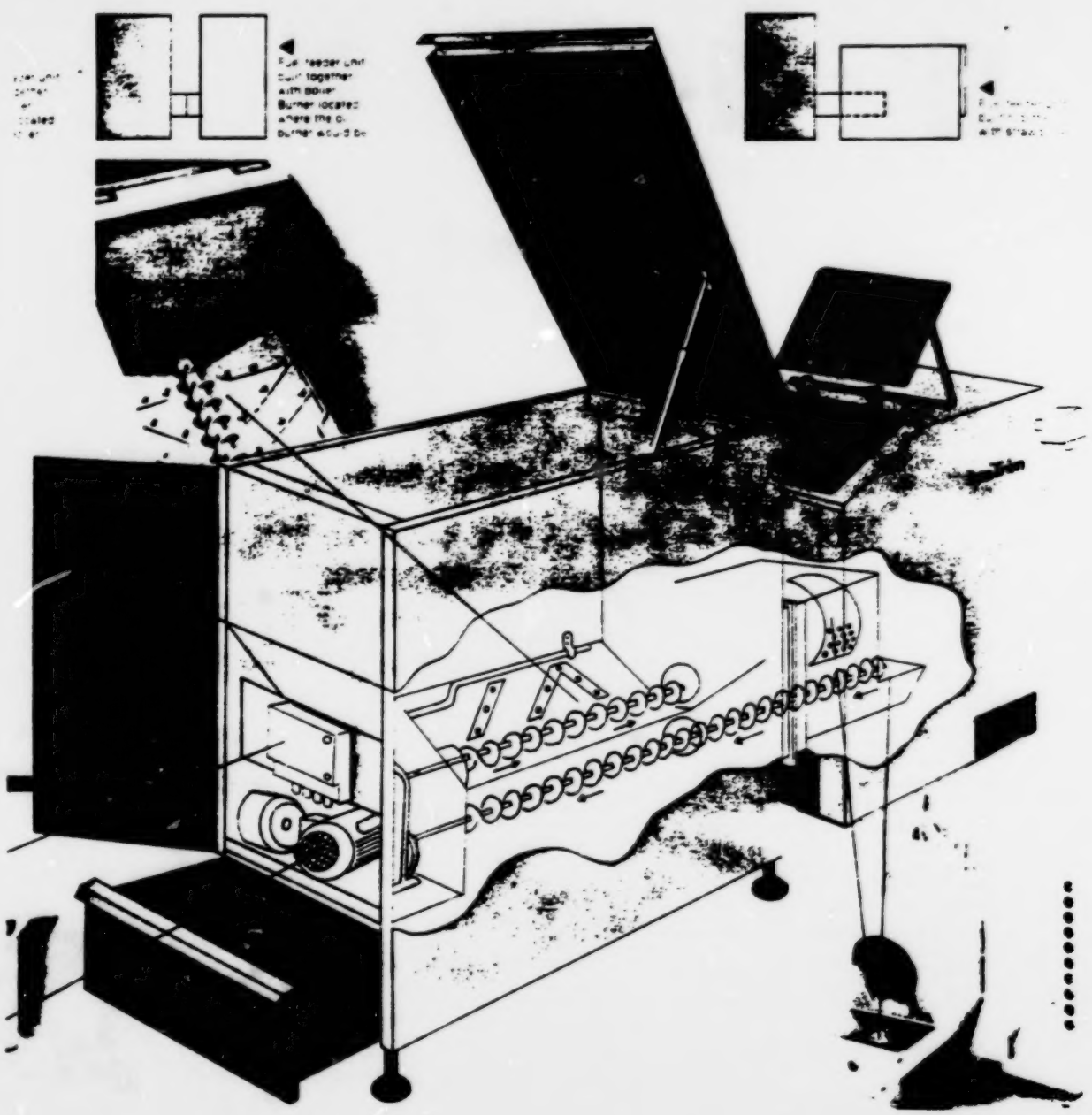


peat pills

straw pills



Various mounting-possibilities for DanTrim Minimatic

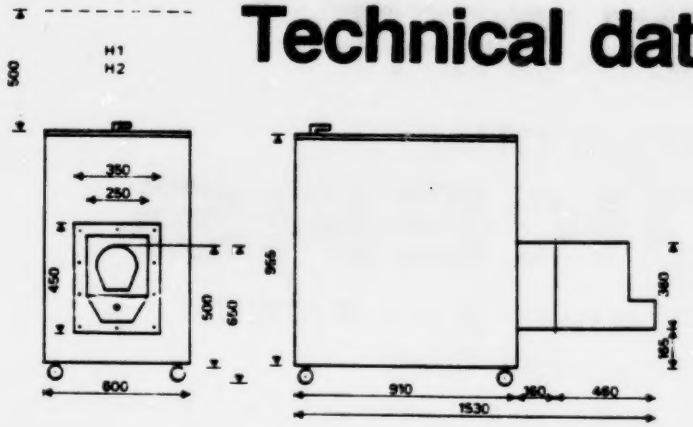


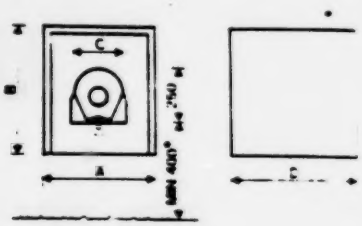
dry sawdust

dry splinter

dry bark

Technical data





	A	B	C	D
Combustionhead 1 Outside 3000-30000 kcal/h	400	480	160	48
Combustionhead 2 5000-50000 kcal/h	460	530	220	52

Flameopening is 250 x C.
* is 150 mm lower without wheels

Weight packing excluded 160 kg
Weight packing included 185 kg
Packing dimens.: length 1.110 mm
width 640 mm
height 1.120 mm
Packed in cardboard-box for export.
Cubic content about 0,8 m³
Cubic content of ashpit: 65 ltr.
(enough for about a month, depending on the ash content of the fuel).

Current supply possibilities:
110 V - 60 Hz. 3 x 440 V - 60 Hz.
3 x 380 V/220 V + 0 - 50 Hz,
1 x 220/240 V - 50 Hz.
Power consumption: max. 1,02 amp.
Connectable to 6 amp. fuse-box.
Complete electronical control based on print-plates.
Working speeds:
Screw conveyor max. 2.9 r.p.m.

By splinter and sawdust 17 r.p.m.
Ash conveyor max. 1.5 r.p.m.
Airfan for incineration: programmed. variable quantity
Co2 measuring after Backaratscale 15%. Co 0.01. Soot stain according to Backaratscala 0-1.
Design and finish: Washprimer and finish coat in brown/yellow.
Reserved the right to alterations

Capacity in tank	fuel	weight in kg	fuel	weight in kg	fuel	weight in kg
Standard (225 ltrs.)	coal	165	splinter	45	straw/peat pills	135
H1 (457 ltrs.)	-	333	-	91	-	27[illegible]
H2 (689 ltrs.)	-	525	-	137	-	4[illegible]

Effect (depending of fuel-type	kW/min	kW/max	kcal/h min	kcal/h max	BTU/h min	BTU/h max
Burner 1	3.6	36.0	3.000	30.000	12.000	120.000
Burner 2	6.0	60.0	5.000	50.000	20.000	200.000
Burner 3	60.0	90.0	50.000	80.000	200.000	320.000

Volumeweight: coal = 730 kg/m³, splinter = 200 kg/m³, straw pills = 600 kg/m³, peat pills = 640 kg/m³

Filling frequency	Standard	H1	H2
coal	about 5 days	about 11 days	about 16 days
straw/peat pills	about 3-4 days	about 6-7 days	about 10 days

Calculation based on 15 l. oil consumption pr. 24 hours (corresponding to a 220 m² well-insulated house).

With conveyance from large silo with flexworm filling frequency can be reduced to one or a couple of times annually.

Dan Trim
MASKINFABRIKEN DAN-TRIM APS
GL. RANDERSVEJ 44 DK 8800 VIBORG
PHONE 06 61 31 11 06 61 32 93
TELEX 66 215 trim dk

IMPORTER/WHOLESALER
Passat Alternate Energy
Lennart Ik P.2.

DEALER

0883-001-2E

WILL-BURT

RESIDENTIAL

STOKERS

HOPPER AND BIN FEED

For Bituminous Coal*

Low Original Cost • Lower Heating or Steam Costs • Low Maintenance Cost

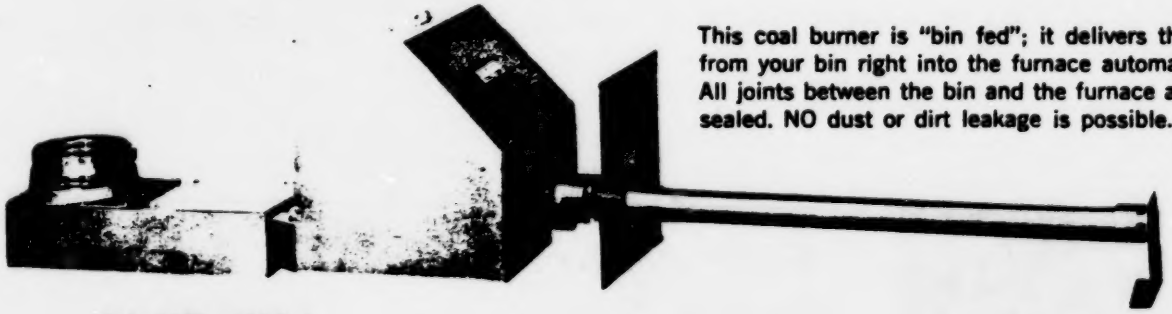
HOPPER MODEL STOKERS

Hopper Capacity 350 lbs.

S-20 (20 lbs. per hour capacity)
S-30 (30 lbs. per hour capacity)

BIN FEED STOKER

Metering coal screw in coal bin • No gear case in coal bin. Remove coal bin worm without moving coal from bin • All drive parts are located between bin and heating plant.



This coal burner is "bin fed"; it delivers the coal from your bin right into the furnace automatically. All joints between the bin and the furnace are well sealed. NO dust or dirt leakage is possible.

BIN FEED MODELS

SB-30 (20 to 30 lbs. per hour capacity)

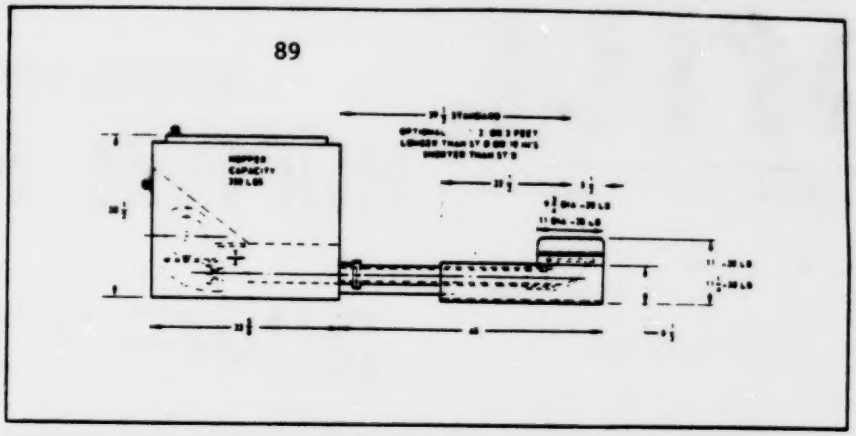
These Stokers Easily Installed In Any Heating Plant

***For Lignite and Sub-Bituminous Coal or Bio Mass Pellet modification, contact Sales Department**

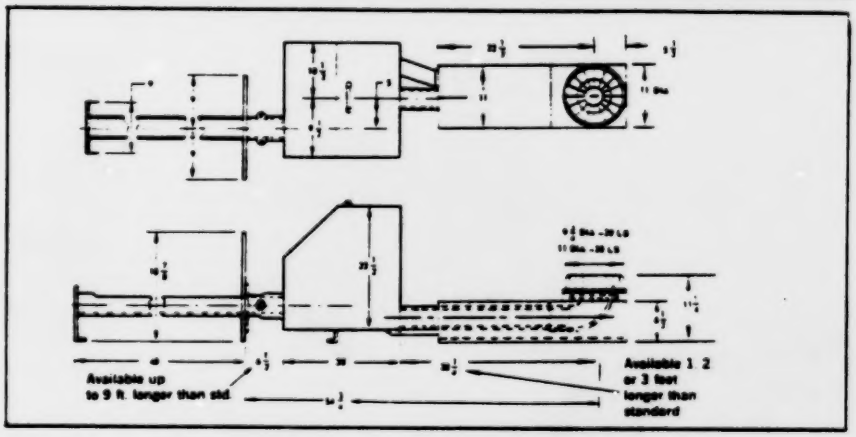
Not For Anthracite Coal

DIMENSIONS and SPECIFICATIONS

20 & 30 LB. HOPPER MODELS



30 LB. BIN FEED MODEL



CONTINUOUS GEAR-DRIVEN TRANSMISSION

Rugged in construction, extremely simple in design and operation — has been tried and proved over a period of many years. All residential models are furnished with this standard transmission, single end shaft motors, and 3-speed pulleys for easy coal-feed adjustments. Gears are made of special alloy. Shear pin for positive protection of all parts.

Stoker fired units develop heat by the safest and most economical method. Automatically controlled temperatures within the furnace as well as throughout the home eliminate fire hazards and prolong furnace life. Stoker heat is CLEAN . . . chimney smoke is eliminated. No grates to shake or dusty ashes to handle. Carefree, automatically regulated heating assures better health for your family . . . gives extra hours for leisure and recreation.

STOKER NUMBER	20	30
COAL BURNING RATE (Approximate Lbs. Per Hr. Continuous Operation)	12 15 20	14 20 30
GROSS OUTPUT 1,000 Btu per hour	156	234
BOILER H P	4 7	7.0
MOTOR SIZE — H.P (Hopper and Bin Feed Models)	1/4	1/4*
HOPPER CAPACITY	350	350
COAL FEED TO BE — Dia (Inches)	3	3
WEIGHT CRATED (Approximate Lbs.) HOPPER MODEL — Refractory BIN FEED MODEL — Refractory	330	330 400

* Bin Feed Model, 1/3 H.P.

SECTIONAL TUYERES — Tuyeres in all burner heads are built in sections to allow for expansion and contraction.

HEAVY-DUTY SCREW CONVEYOR — The conveyor screw is made of special high carbon steel, making it highly resistant to abrasion and wear.

HEAVY-DUTY MOTOR — Thoroughly tested and proved by engineers for higher starting power and extra years of trouble free performance. No radio or television interference.

EXTENDED WIND BOX — This makes it easy to clean out siftings underneath the tuyeres

Ask for Information About Stokers for Commercial and Industrial Applications

The Will-Burt COMPANY
ORRVILLE, OH. 44667
Phone 682-7015 Area 216

Form No. W824-84-03

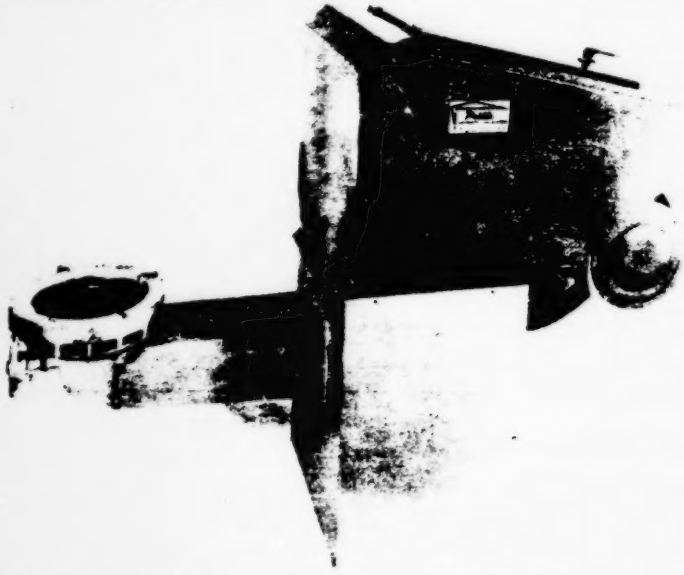
prill
SOLID FUEL HEATING

MODELS 100 and 200
HOPPER STOKERS

PHONE 307—672-5801
DRAWER S SHERIDAN, WYOMING 82801

STOKER FIRING
BIO MASS FUEL or STOKER COAL

RING 'O' FIRE

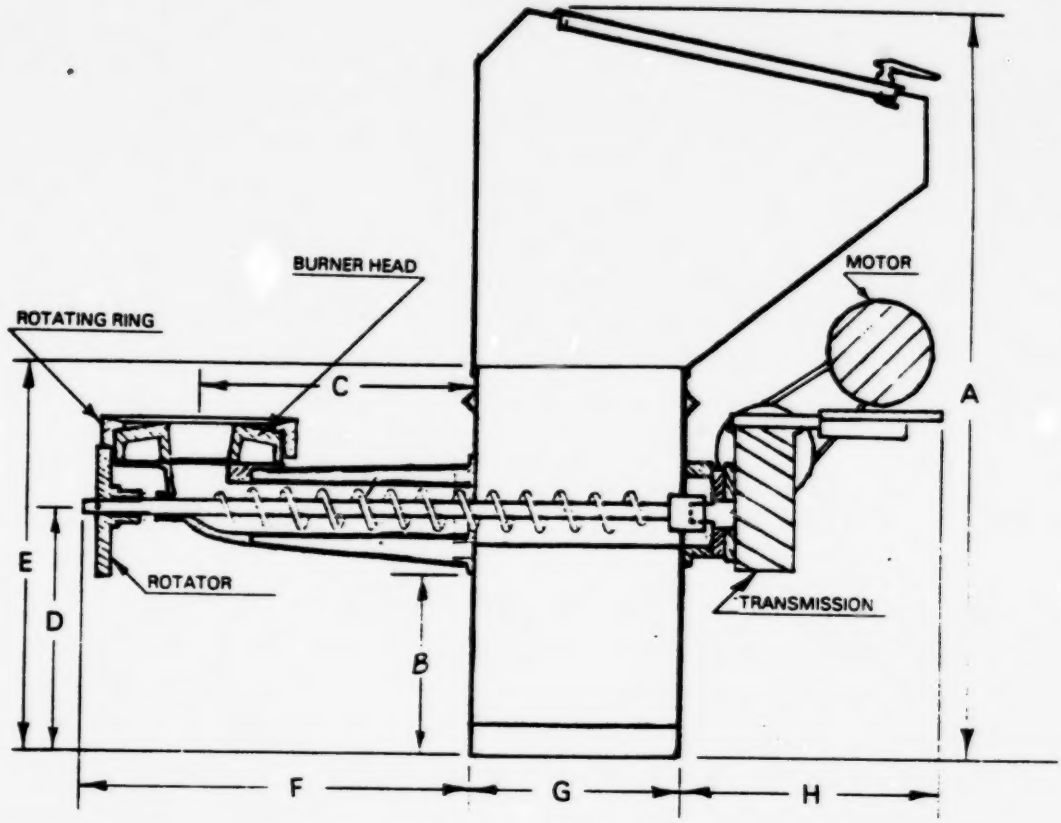


NO CLINKERS
PMC burner head with rotating ring is the heart of the unit. The design controls combustion for more even heat production. Ash falls evenly off the outer edge of the ring, eliminating clinker build up, as fresh fuel is pushed up through the center of the head.

- PRILL'S UNIQUE BURNER HEAD DESIGN ALLOWS EVEN, CONTROLLED COMBUSTION. NO FIRE BRICK REQUIRED.
- NO MORE MESSY CLINKER REMOVAL—PRILL'S BURNER HEAD DESIGN AND ROTATING RING PREVENTS CLINKER FORMATION.
- LIGHT ONCE AND FORGET IT—HOLD FIRE TIMER ASSURES A LIVE BED OF COALS AND INSTANT HEAT WHEN NEEDED.
- ENJOY THE WARMTH AND COMFORT OF COAL HEAT OR BIO MASS FUEL.*
- COAL & BIO MASS FUEL IS THE ONLY ECONOMICAL FUEL AVAILABLE—SAVE AS MUCH AS 50% OVER OTHER FUELS.
- AUTOMATIC HEAT IN A SINGLE PACKAGE.

* Bio Mass Fuel — All vegetative material in pellet form.

NOTE: FOR USE WITH SUB-BITUMINOUS, LIGNITE COAL AND BIO MASS FUEL.



	A	B	C	D	E	F	G	H
MODEL 100	43½	10½	16	14¾"	22½	22	12	16½
MODEL 200	44	10½	20	14¾"	22½	26½	16	17½
MODEL 200 - Long Nose -*			38			44½		

* Dimensions C and F will vary with nosing length.

MODELS	100H	200H
Minimum Fire Box Diameter	18"	20"
Size	12"	14"
Stoker Motor H.P.	¼	¼
Flue Size	6	8
*Lbs. Coal Fed Per Hour-Max. Hopper Capacity	16 280-Lb. Coal – 212-Lb. BM	30 340-Lb. Coal – 258-Lb. BM
Type Vent Required	All Fuel	All Fuel
Recommended Height of Chimney Above Roof Peak	30"	30"
Approximate Shipping Wt.	260 lbs.	321 lbs

(Specifications subject to change without notice)
No Electronic Control Panel Included (Stoker Relay Timer)

Voltage-110V

* Coal Feed Varies With Different Types of Stoker Coal or Bio Mass Fuel.

5.0 CAPITAL COSTS OF CONVERSION

5.1 GENERAL

Estimates of the capital costs required to convert various existing oil fired heating systems and buildings over to the predominant use of wood fuel for space heating are assembled in this section. The viability or economic sensibility of undertaking these investments is discussed in Chapter 6.0. The capital costs to establish a wood fuel harvesting and delivery operation to meet the needs of expanded wood fuel use are also addressed in this section.

The individual cost estimate elements are based upon specific equipment quotations in certain cases. Due to the wide variety of specific circumstances for installation of equipment in particular buildings or dwellings, the cost estimates presented covering installation services, time and materials etc. are somewhat generalized. The costs are based upon discussions with contractors and firms "in the business" concerning labour rates and amount of work involved in dealing with various installation circumstances. In keeping with the intent and purpose of this study, a common budget estimate is developed for the installation of a particular type of equipment into a typical building application. Variances from the budget are possible in particular cases, but the estimate is expected to be reasonable on average.

All costs and prices are early to mid 1984 time frame figures.

5.2 WOOD STOVES

The capital costs to install a wood stove into an existing living space are assembled in Table 5.2/1. The exact costs in any particular installation may vary slightly due to the exact purchase price of the equipment selected, chimney configuration and length, building modifications to accommodate the chimney, etc. The estimated cost for a wood stove installation is $2300. This cost could be reduced to as low as $1500 if the owner supplied the installation labour, only 10 ft. (3 m.) of chimney was required, and the side heat reflectors were not desired.

The wood stove size selected as the basis for costing is judged to be suitable for most private dwellings where a wood stove was suggested.

Table 5.2/1 WOOD STOVE PACKAGE
INSTALLED CAPITAL COSTS

#	DESCRIPTION	COST $
1.	Wood Stove[2] - unit quantity - F.O.B. Rae Edzo	$ 850.00[1]
2.	Chimney[3] - ULC Class A prefabricated 6" dia. flue pipe - 16' length plus misc. brackets - F.O.B. Rae Edzo	670.00
3.	Hearth and Side Heat Reflectors[4] - non combustible sheets - optional to reduce clearances to combustible surfaces	320.00
4.	Flue Pipe Cleaning Tools - brush and 20 ft. of rods	60.00
5.	Installation Costs[5]	
	- Labour	360.00
	- Materials	40.00
	ESTIMATED TOTAL COST	$2300.00

5.3 WOOD FURNACES

The capital costs to install a stand alone or an add-on wood furnace, or combination wood/oil furnace are assembled in Table 5.3/1. The costs are based upon the installation of a Model F-100 wood furnace, made by REF Energy Ltd., or a Duomatic Olsen Inc. Model BBC-112 wood/oil combination unit. The estimates assume that heat distribution ducts are already in place and are installed with proper clearances for a wood burning appliance. The sheet metal plenum to link the wood furnace to the existing oil furnace, and to the distribution ducting is costed as shown.

Installation costs were estimated by Yellowknife tradesmen under the assumption that adequate space exists to add the new wood furnace. Costs to add heat reflectors on combustible walls to permit reduction in clearances are extra. Costs to build porches, added rooms, etc. to accommodate equipment were not estimated.

Installation expenses could be reduced somewhat if a number of similar installations were done at the same time, if local labour was used to set up or prepare the furnace on site instead of using tradesmen, or if all installation work except the sheet metal fabrication was performed by the occupant.

The cost of a wood furnace stoker is shown as an option. Since all installations are assumed to have oil fired back-up heating, the stoker may be a desirable item but is not essential.

The installed costs for an add-on, or a stand alone wood furnace are estimated to be similar, i.e. $5070 - $5140. The cost to purchase and install a stand alone oil fired furnace in the same situation would be $4200 - $4500.

The combination wood/oil unit is not markedly different in price from a stand alone wood furnace. Considerable flexibility seemed to exist in price levels for furnace units depending on the furnace make, point of sale (Yellowknife, Edmonton or factory), and volume purchased. Single purchase, NWT point of sale retail prices were used.

The following notes apply to the tabulated figures:-

(1) All costs are early 1984 figures in the community, unless otherwise noted.

(2) Wood stove costs were based on an Osburn Regent (6" flue) and similar sized units. Prices courtesy Woodstove Shop, Yellowknife, and Alternate Energy Supplies Ltd., Hay River.

(3) Chimney price is based on the "SUPERSERIES" 2100°F rated chimney newly adopted in the Code.

(4) Typical protection barrier products are Hearthshield and Coolcrete. Cost based on a 4' x 5' hearth and two 3' x 4' wall protectors.

(5) Installation costs assume a tradesman is hired to install the chimney. Flashings and chimney support materials are included in item 3. A miscellaneous materials allowance is indicated. A labour rate of $30.00/hour is assumed.

Table 5.3/1 WOOD FURNACE

INSTALLED CAPITAL COSTS

#	DESCRIPTION	ADD-ON FURNACE COSTS ($)	STAND ALONE FURNACE COSTS ($)	COMBINATION WOOD/OIL FURN. ($)
1.	Wood Furnace			(1)
	- RSF Energy F100	$1850.00[1]	$1850.00	
	- F.O.B. Rae Edzo			
	- Duomatic/Olsen CWO-B112			$2550.00
2.	Wood Furnace Accessories[2]			
	- Forced Air blower	n/a	400.00	incl.
	- Thermostat control unit	n/a	200.00	incl.
3.	Chimney[3]	800.00	800.00	800.00
	- ULC approved superseries			
	- 8" flue diameter			
	- 16' length plus misc. brackets and supports			
4.	Heat Reflector[4]	-0-	-0-	-0-
5.	Flue Cleaning Tools	60.00	60.00	60.00
6.	Installation Costs[5]			
	- Chimney	360.00	360.00	360.00
	- Furnace Placement	300.00	300.00	300.00
	- Tie-in ductwork	1100.00	820.00	820.00
	- Misc. materials	600.00	350.00	350.00
	TYPICAL TOTAL INSTALLED COST	$5070.00	$5140.00	$5240.00
Option:				
1.	Small Capacity Wood Chip Stoker Unit[6]	$4500.00	$4500.00	$4500.00
	Allowance for Installation	$ 500.00	$ 500.00	$ 500.00
2.	Large Capacity Wood Chip Stoker Unit[7] and Feed System	$15650.00	$15650.00	$15650.00
	Minimum Allowance for Installation	$ 2000.00	$ 2000.00	$ 2000.00

The following notes apply to the tabulated figures:-

(1) All costs are early 1984 costs in the Rae Edzo community unless otherwise noted. Prices are courtesy of Alternate Energy Supplies Ltd., Hay River, and verified elsewhere.

(2) The add-on furnace makes use of the blower in the prior existing oil furnace.

(3) A new separate flue for the wood furnace is assumed. In certain cases, the new unit may be tied into the existing chimney flue.

(4) No side reflectors are included, as adequate side clearances are assumed to be available. The base reflector is not usually required.

(5) The tie-in ductwork is assumed to include a supply plenum above the wood furnace, 6 feet of ductwork from the plenum to reconnect to existing ductwork, and reducting of the oil furnace supply plenum to the wood furnace air inlet. No allowance is made for the cost of additional physical room space that may be necessary in certain specific cases to accommodate the second furnace. Costs are estimated based on tradesman rates and travel allowance for sheet metal trades from Yellowknife. Rates of $30.00/hour for chimney installation, and $35.00/hour for sheetmetal fabrication are assumed. Costs are based on estimates for single installation jobs in Rae Edzo by Knutsen Sheet Metal, and JSL Mechanical Installations Ltd., of Yellowknife.

(6) Cost estimated based on a Dantrim Minimatic Model DT30 automatic fuel stoker unit (120,000 BTU/hr. max. fuel supply rate), F.O.B. Rae Edzo. Unit has 0.7 m^3 (25 $ft.^3$) chip storage capacity.

(7) Cost estimate based on a Northfab Industries Stoker without Retort, 10 m^3 cylindrical silo and auger outfeeder F.O.B. Rae-Edzo.

5.4 WOOD BOILERS

5.4.1 Residential

A residence with an oil fired hot air furnace could be converted to wood fuel using a wood boiler. A heat transfer coil is installed in the supply plenum of the existing oil furnace. Hot water is supplied to the coil from a wood boiler unit. Furnace air is circulated past the coil to absorb heat using the furnace blower. The wood boiler thermostat (combustion air damper) control is set 1 - 3°C above the oil furnace thermostat.

This type of installation may have an advantage over the installation of a wood furnace if the existing ductwork clearances were inadequate or if ceiling joist space was previously used as the return air ducts, and extensive duct reinstallation costs were necessary. Otherwise the cost of this form of installation exceeds the add-on furnace option by perhaps $1000 - $1200.

This wood conversion configuration was not advocated for any residential installations in the community.

5.4.2 Institutional and Municipal

a) Prefabricated Wood Boiler Plants

The Nishi Khon Centre in Rae and the Jimmy Bruneau School in Edzo may be converted to wood energy consumption by the addition of a separate boiler plant, erected adjacent to the existing building. A factory prefabricated packaged wood fired heating plant, probably suitable for these installations, is manufactured by Robert Bell Industries Ltd. in Seaforth, Ont. The unit is a Northfab Systems Inc. (Thomasville, North Carolina) basic package and is delivered complete, ready for placement on a foundation and for start-up.

The packaged plant includes a Northfab wood fired hot water boiler, 1200 $ft.^3$ (8 - 10 chipped cords) chip fuel storage bin, and automatic bin to boiler fuel feed system. The building is a steel structure with a heavy gauge box beam frame, interior and exterior steel clad walls. Walls, ceiling and floor are insulated with high density urethane. The breeching and chimney are included as part of the package. The chimney is erected adjacent to the building structure. The building is prewired and all boiler plant controls are installed ready for operation. Required connections to the plant include power, hot water supply (out) and cold water return (in). Return water pump and tank can be provided or existing equipment can be employed. The building frame can accommodate a rough timbers foundation or a permanent concrete foundation. The building is typically 10' wide, 10' high and up to 40' long depending on the boiler equipment and fuel feed equipment in place. The unit is tested at the factory prior to shipment.

A unit with a supply capacity of 1.5 million BTU/hr (440 kw) would be suitable for the Nishi Khon Centre if existing oil fired units are retained for back-up. A 5.0 million BTU/hr (1465 kw) unit could likely carry the full heat load at the Jimmy Bruneau School on all but the coldest winter days. A single wood boiler would be suitable due to the availability of oil fired back-up heating equipment.

The unit is factory shipped to the community on a flat bed truck. Installation on a prior prepared foundation would require a crane for chimney erection and a bulldozer to assist with building off loading and placement.

The capital costs to procure and install a Bell-Northfab prefabricated facility are assembled in Table 5.4/1. The estimates assume a standard boiler package is purchased without tendering or generic design work by engineering consultants on behalf of an owner/client.

No costs are identified to cover the planning, application for funding, decision process or other preliminary administrative activities an owner may undertake prior to approving a project to proceed.

No costs were assumed for the land to be occupied by the boiler facility. Electrical, water and sewer services were assumed to be available in the immediate vicinity (less than 30 m.). Tie-in costs for these services were included in the "Tie-In Existing Facilities" estimate.

A concrete chimney foundation is assumed. On the advice of GNWT DPW, a gravel pad and timber foundation for the skid framed boiler building is assumed, with wedged jack points etc. for periodic releveling of the structure.

GNWT Public Works, the operator of the J. Bruneau School, or the Rae Edzo Dene Band Economic Development Corporation (Nishi Khon Centre operators) should assign a manager to the wood boiler installation project once executive decision has been reached to proceed with a project. The job of the project manager may include contract negotiations with the boiler facility vendor, and installation contractors; iron out technical interface details; arrange for site preparation, foundation preparation, municipal services such as power, sewer and water; co-ordinate work schedules; monitor the quality and correctness of the site work; formally accept the completed installation; etc.

The project manager may also be utilized to set-up and negotiate the first fuel wood supply contracts.

Table 5.4/1 PREFABRICATED WOOD BOILER FACILITY
INSTALLED CAPITAL COSTS

#	DESCRIPTION	Nishi Khon Centre	Jimmy Bruneau School
1.	Prefabricated Wood Boiler Facility - F.O.B. Seaforth, Ontario	$86800.00	$122500.00
2.	Shipping to Rae Edzo, N.W.T.	9200.00	9200.00
3.	Foundation Preparation	5500.00	5500.00
4.	Off-Loading On-Site - building & chimney	2400.00	2400.00
5.	Tie-In to Existing Facilities	10700.00	9500.00
6.	Start-up/Commissioning	4500.00	3400.00
7.	Owner Project Management	contracted 20,000.00	internal -o-
	TOTAL	$139100.00	$152500.00

b) Boilers Added in Existing Buildings

The Cottage Hospital in Edzo and the new equipment garage in Rae (owned by the Hamlet) are good candidates to install wood boilers within their existing building spaces. In both cases a 350 - 400,000 BTU/hr single wood boiler would be suitable to carry the heat load except perhaps on the coldest winter days. A single unit is suggested assuming the present oil fired equipment is kept for stand-by service. A 12 boiler H.P. (401,700 BTU/hr) rated Robert Bell Industries SYNCRO Dual-Pak Series II Model #DUK-12-W-30#W wood fired hot water boiler was selected as a possibly suitable unit for this application. The costs to install this boiler in each of the two named buildings are assembled in Table 5.4/2.

Table 5.4/2 WOOD BOILER
INSTALLED CAPITAL COSTS

#	DESCRIPTION	New Hamlet Garage	Cottage Hospital
1.	Wood Fired Hot Water Boiler - R. Bell Industries Syncro Series II - 12 b.H.P. - F.O.B. Rae Edzo - Controls included	$ 8600.00 (1)	$ 8600.00
2.	Breeching and Chimney - 25 cm. diameter - 15 m. high - F.O.B. Rae Edzo	2800.00	2800.00
3.	Wood Fuel Feed System, $10m^3$ silo - Northfab Industries - F.O.B. Rae Edzo	15650.00	15650.00
4.	Placement on Location (2)	3200.00	11600.00
5.	Tie-In to Existing Facilities (3)	5800.00	2000.00
6.	Start-up/Commissioning - Factory Service Engineer	3400.00	3400.00
7.	Project Management	6000.00	9500.00
	TOTAL	$45450.00	$53550.00

Notes:-

(1) 1984 costs in Rae Edzo, unless otherwise noted.

(2) Placement costs are based on the Cottage Hospital installation and include, unloading from shipper, destruction and repair costs to place the boiler into position, erection of chimney and feed system, etc. Similar costs for the new Hamlet equipment garage are low due to direct access to desired location.

(3) Separate fan equipped heat transfer coils are installed in the Hamlet garage for the wood boiler.

5.5 CENTRAL HEATING PLANTS

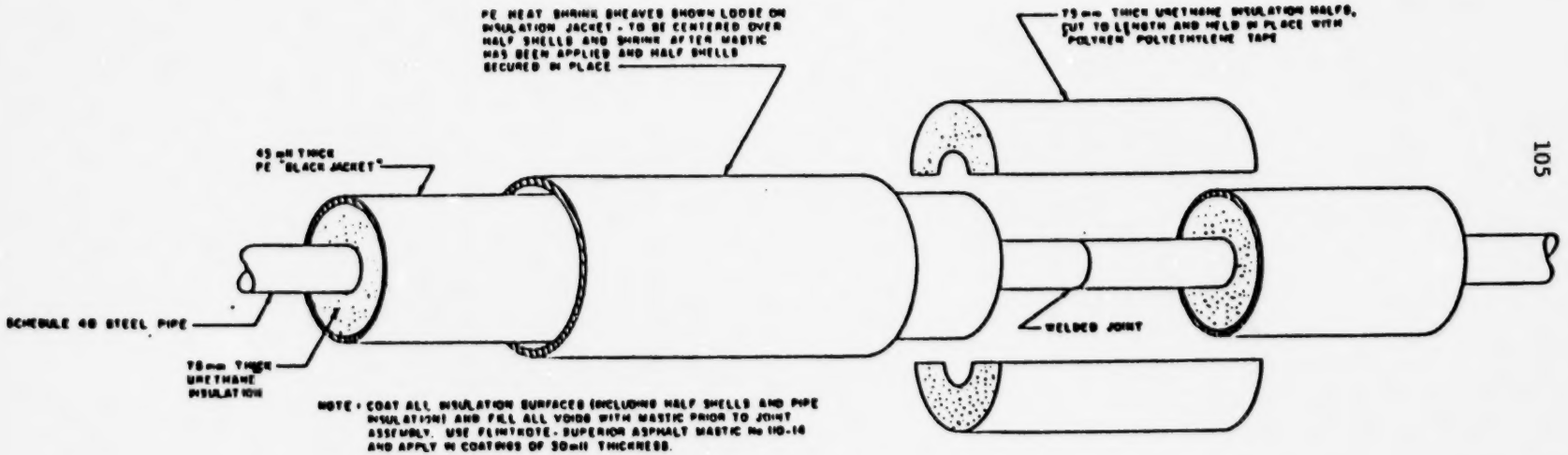
The size of heating load and proximity of the various community buildings were studied to identify possible sets of buildings that may effectively be served by a single centralized heating plant. Three criteria in the selection of a group of buildings are: compatibility of internal building heat distribution equipment to a centralized steam or hot water based heating system; close proximity of heating loads to the central boiler plant; and largest possible heating loads. A significant number or building configurations could be conceived. A representative four configurations, possibly the most viable configurations, are discussed in detail here.

A key cost factor in the assessment of potential for a district heating system is the cost to install a hot water or steam supply line and a cold water return line between the boiler plant and the load. The actual cost per unit linear distance is dependent on line diameters, insulation thicknesses employed, and depth and terrain traversed by the trench.

Costs for heat distribution lines, assuming two insulated pipes (hot water supply, cold water return) both buried in the same trench were sought from a number of sources. The figures noted below, estimated to apply on average across the whole of the N.W.T., were taken from ref. 17 and are in 1980 dollars.

DISTRIBUTION MAINS

Size	Installed Cost
51 mm	$200/m
63 mm	$230/m
76 mm	$250/m
102 mm	$300/m
126 mm	$360/m
152 mm	$400/m


PE HEAT SHRINK SHEAVES SHOWN LOOSE ON INSULATION JACKET - TO BE CENTERED OVER HALF SHELLS AND SHRINK AFTER MASTIC HAS BEEN APPLIED AND HALF SHELLS SECURED IN PLACE
75 mm THICK URETHANE INSULATION HALFS, CUT TO LENGTH AND HELD IN PLACE WITH "POLYKEN" POLYETHYLENE TAPE
45 mil THICK PE "BLACK JACKET"
SCHEDULE 40 STEEL PIPE
75 mm THICK URETHANE INSULATION
WELDED JOINT
NOTE: COAT ALL INSULATION SURFACES (INCLUDING HALF SHELLS AND PIPE INSULATION) AND FILL ALL VOIDS WITH MASTIC PRIOR TO JOINT ASSEMBLY. USE FLINTKOTE - SUPERIOR ASPHALT MASTIC No 110-14 AND APPLY IN COATINGS OF 30mil THICKNESS.

DISTRIBUTION PIPING INSULATION METHOD

Figure Courtesy Reference 17

BRANCH CONNECTIONS

Type	Installed Cost
Non-Industrial	$ 5,000.00
Industrial	$15,000.00

Discussion with GNWT DPW engineers suggest that a present day budgeting figure for laying polyethylene sewer and water lines, factory insulated with urethane, yellow jacket coated, and buried in permafrost is $400 - $500/m, installed. From these general figures, and general intercomparison with Rae Edzo conditions, a heat supply main distribution line installation cost of $600/m was assumed, with residential tie-ins at $7,000, industrial branch connections at $20,000, and lateral distribution lines installed for $400/m.

In each case, a wood boiler with a hot water output (as opposed to low pressure or high pressure steam) was assumed. A life-cycle cost tradeoff between water, l.p. steam and h.p. steam is generally part of any detailed installation design exercise. Steam boilers are more expensive, and depending on size, are more likely to require constant operator surveillance by more qualified personnel. Steam boilers also require more careful attention to conditioning the internal boiler water solution. However, steam boilers permit smaller diameter distribution lines and result in reduced operating costs to deliver the energy to the remote loads. Hot water based units for the centralized "district" heating installations were assumed in order to be consistant for comparison purposes with the boiler units serving the individual loads. The N.W.T. Boilers and Pressure Vessels Ordinance indicates that all boiler installations described in this report are "heating plant class" installations and are generally supervised by a Building Operator B Certificate of Proficiency holder (six months experience, and pass an examination).

a) Nishi Khon Area

A central heating plant located near the present Nish Khon Centre could serve the following buildings: Nishi Khon Centre, Warehouse and Adult Education Centre, Hamlet Workshop, Roman Catholic Church and Mission, and the proposed Rae Old Folks Home (see Appendix 3 map). The total installed heating capacity of these buildings is estimated to be 3.8 million BTU/hr, with the Nishi Khon Centre and the proposed Old Folks Home accounting for perhaps 3.0 million BTU/hr.

Upon further consideration, the church and mission likely would be marginal candidates for inclusion in a district heating system. As noted in the site visit notes, Appendix 4, the church heat requirements are low since it is heated only for a few hours per week, and the mission may be most effectively wood heated with wood stoves or a wood furnace add-on to the existing oil furnace. The 172,000 BTU/hr mission furnace is located approximately 175 m. southwest from the Nishi Khon Centre boiler room. The adult education centre furnace room is perhaps 35 m. north of the Nishi Khon Centre furnace room, with building foundations less than 10 m. apart. The tie-in between buildings could be laid at ground level and covered with a service box.

The Hamlet Workshop is located approximately 70 m. northwest of the Nishi Khon Centre. A buried heat supply line would be required. The proposed Old Folks Home may be situated 80 - 110 m. southeast of the Nishi Khon Centre. A buried heat supply line including a road crossing is required.

The estimated capital costs for this district heating system are assembled in Table 5.5/1. The costs are arranged in a manner to identify the incremental costs required to tie-in each additional heating load to a baseline boiler plant. The costs are based on the installation of a Robert Bell - Northfab prefabricated, packaged wood fired hot water boiler plant along the northeast wall of the Nishi Khon Centre. The initial installed capacity for the Nishi Khon Centre only is assumed to be 1.5 M BTU/hr as discussed earlier.

Table 5.5/1 NISHI KHON CENTRAL HEATING PLANT

#	DESCRIPTION	COST
1	Installed 1.5M BTU/hr boiler plant to serve the Nishi Khon Centre only (from Table 5.4/1)	$139,100.00
2	Old Folks Home Addition	
a)	incremental cost to add 1.0M BTU/hr boiler capacity	12,000.00
b)	cost to install and tie-in 110M of buried hot water supply and return lines	66,000.00
c)	terminal water/water heat exchanger	4,500.00
d)	heat energy metering equipment	3,000.00
	Sub Total	$ 85,500.00
3	Adult Education Centre/Warehouse Addition	
a)	incremental cost to add nil boiler capacity	-0-
b)	cost to install and tie-in 35 m. of water supply and return lines (25 m. inside building space)	13,500.00
c)	2 furnace heat exchange coils, purchase & install	2,800.00
d)	heat energy metering equipment	3,000.00
e)	heat demand controls purchased and installed	1,200.00
	Sub Total	$ 20,500.00
4	Hamlet Workshop Addition	
a)	incremental cost to add nil boiler capacity	-0-
b)	cost to install and tie-in 70 m. of water supply and return lines	42,000.00
c)	furnace heat exchanger coil purchase & install	2,600.00
d)	heat energy metering equipment	3,000.00
e)	heat demand controls purchased and installed	1,200.00
	Sub Total	$ 47,800.00

The central wood boiler plant capital costs for an Old Folks Home internal hot water distribution system for space heating are excluded from this synthesis since a suitable system is required as part of the building capital cost in any case. An allowance for heat energy metering equipment is included for each added load. The equipment, probably consisting of a flow rate meter, temperature transducer, signal processor and data recorder, is useful to properly allocate energy charges to the various "customers".

Heat transfer coils must be added into the furnace supply air plenums in two of the buildings to transfer heat from the hot water supplied by the central boiler plant to the building air handling system.

A thermostat, solenoid valve, and components to control the hot water flow based on building demand are included in the estimate for each additional building.

b) Rae School and Rae Recreation Centre

These two buildings are not part of the current building stock. However the recreation centre, complete with an oil fired heating system started construction in early 1984, and the new primary school is tentatively slated for 1986 construction (Appendix A4.3). The buildings are expected to be located close together, and may have a combined fuel oil consumption of in excess of 100,000 litres. The actual consumption is uncertain at present since planning for the school very preliminary, and the utilization (and hence heating costs) for the recreation centre has not been determined. Accordingly, no capital or operating costs for the installation of a central wood boiler plant were estimated. However, on the surface, this building group appears to be a good candidate for a single centralized wood boiler plant and considerations in this vein should be worked into planning for the school.

c) Central Heating of Residential Dwellings

A cluster of residential housing in the Rae community may be heated economically from a centralized boiler plant. A row of 10 yellow exterior finished NWTHC houses are located east-west along a single lane, one street north of the main road into the centre of Rae. From the easternmost home in this group, a second row of 12 homes are aligned north-south on a single lane. A third row of new homes on a parallel street east of row two, is presently under construction. A central boiler plant may be located at the intersection of row one and two (see map pg. A3.4). One heat supply line could run westward to tie-in all of the yellow houses in row one. A second supply line could run northward to tie in homes in rows two and three. To fix a concept for consideration here, it was assumed that 25 homes, each with an annual fuel oil consumption of 4000 litres are supplied from the central plant. Lateral heat supply lines would run from the passing main trunk supply pipe into each individual home. A heat transfer coil must be mounted in each home furnace supply air plenum. The coil, heated by the central boiler supplied hot water, is cooled by air circulated through the coil by the home furnace blower. Depending on specific circumstance, blower sizes or drive pulley's may need to be changed slightly to accommodate the increased plenum air pressure drop. Also an additional blower activating temperature transducers (in addition to the flue gas stream "furnace stat") must be mounted within the supply plenum to ensure proper operation of the blower. A separate thermostat, controlling a hot water supply valve and associated hardware is added to regulate water supply to the home heat demand. The existing oil furnaces are retained for back-up purposes (and to make use of their blowers). Metering equipment to measure the heat energy supplied to each home is included in the estimate.

The central boiler plant assumed is again a prefabricated, packaged wood fired hot water boiler facility complete with an automatic wood chip feed system and fuel silo to handle wood chip fuel. A 4.0M BTU/hr capacity unit is assumed to accommodate all 25 home loads and to provide some allowance for distribution line heat losses. The distribution system is assumed to consist of two main trunk lines; a 300 m. buried supply

line and cold water return running westward; a similar 250 m line pair running northward. 25 m. long lateral supply lines are assumed necessary to tie each home into the trunk line.

All lines are assumed to be insulated to a 3" radial thickness and buried to a depth of 4 ft. The land in this portion of town is mostly gravel-sand without rock outcrops, facilitating line burial.

An estimate of capital costs is assembled in Table 5.5/2.

d) RCMP Buildings

The RCMP detachment office, workshop and three officer's residences are closely spaced at one location in Rae (Appendix 4.3). All buildings except the NCO's house are linked with a utilidor to distribute power and water. A potentially viable concept may be to install a central wood fired hot water boiler unit in the workshop space and to supply hot water for space heating to each of the buildings through the utilidor. A 600,000 BTU/hr capacity boiler is assumed to be suitable to carry the various heat loads and to overcome distribution line losses.

Heat transfer coils must be installed in the oil furnace supply air plenums in each building to deliver heat to the air distribution ductwork. A separate thermostat, solenoid activated hot water supply valve and associated hardware are required in each case to regulate hot water flow to the coil to match heat demand.

An estimate of the capital costs for this installation is assembled in Table 5.5/3.

Table 5.5/2 RESIDENTIAL DWELLINGS
CENTRAL HEATING FACILITY
CAPITAL COSTS

#	DESCRIPTION	COST
1	Central Wood Boiler Plant	
a)	prepackaged Robert Bell Industries plant 4.0M BTU/hr capacity	$111,500.00
b)	shipping to Rae Edzo	9,200.00
c)	foundation preparation	5,500.00
d)	placement on site	2,400.00
e)	tie-in municipal services (sewer, water, electricity)	10,700.00
f)	start-up/commissioning	3,200.00
g)	project management (contracted)	20,000.00
	Sub Total Item #1	$162,500.00
2	Install 550 m. of insulated buried hot water supply and cold return lines for main trunk distribution	330,000.00
3	Per Dwelling tie-in costs	
a)	install 25 m. of insulated, buried hot water supply and cold water return for lateral distribution	17,000.00
b)	furnace heat transfer coil installed and tied into hot water laterals	1,600.00
c)	heat energy metering equipment	3,000.00
d)	thermostat and controls for hot water demand, installed	1,200.00
	Sub Total Item #3	$ 22,800.00

Table 5.5/3 RCMP FACILITIES
CENTRAL HEATING SYSTEM
CAPITAL COST

#	DESCRIPTION	COST
1	Bell Industries Dual Pak Series II DUK-20-W-30#W Wood Boiler - F.O.B. Rae Edzo, F.S.T. exempt	$ 13,800.00
2	Northfab Industries Underfeed Stoker - 10.0m^3 fuel silo - F.O.B. Rae Edzo	15,650.00
3	Chimney and Breeching - 25 cm. diameter - 15 m. high - F.O.B. Rae Edzo	2,800.00
4	Placement on Location - boiler foundation preparation - chimney and feed system erection	2,200.00
5	Installation of water distribution lines(1) - all but the NCO house	25,000.00
6	Installation of furnace heat transfer coils and heat controls - 4 buildings excluding NCO house	11,200.00
7	Tie-ins at boiler	4,100.00
8	Start-up/commissioning	3,700.00
9	Project Management - contracted	15,000.00
	Sub Total	$ 93,450.00
10	Incremental cost for NCO house tie-in	
a)	Build 50 m. of new utilidor and install hot water lines	30,000.00
b)	furnace heat transfer coil and demand controls installed and tied-in	2,800.00

Notes:

(1) Assume 100 m. of existing utilidor is opened and hot water lines installed at $250/m.

5.6 WOOD HARVESTING EQUIPMENT COSTS

The present harvest by Rae Edzo residents is estimated to be 1800 - 2200 cords per year. Approximately 1700 cords of this total are supplied by one contractor to Social Services, for use by families under their support. This contract has been awarded on an annual basis recently in response to tender. The contract has changed hands over the years indicating that more than one business or entrepreneur apparently has the capacity to do the job.

The present harvesting technique is a non-mechanized one where trees are felled and trimmed by chainsaw, cut to hand carryable lengths, toted to loading points and loaded onto a 5 ton, single axle flat bed truck for delivery in town.

Exerpts from a recent jackpine fuel wood inventory survey (Appendix 5) performed on a nearby fire burned area (the most popular present source of fuel wood) indicate that log skidders or other mechanized harvesting equipment would damage the regenerating forest, and are not appropriate in any case since only 10 - 15% of the timber is greater than 18 cm. in diameter (breast high). More than half of the timber is less than 14 cm. diameter.

Accordingly, a similar low capital intensive approach is projected for fuel gathering in response to increased community wood fuel demand spawned by the conversion program outlined in this report. The low mechanized approach is consistent with regional Forestry preferences and the acute need for employment in the community.

The capital costs of appropriate wood harvesting equipment are indicated in Table 5.6/1. The synthesized cost of wood fuel, harvested, and supplied to the user, is assembled in Section 6.0 from these costs.

The capital costs show a substantial price to be paid for a wood chipper. Chippers can be purchased within the price range from $2000 to in excess of $150,000 per unit. As witnessed by experiences with chipping and chip fuel augering in Fort Smith, and with automated chip augering systems in general, the smooth delivery of wood chips through augering equipment is highly dependent on chip characteristics. Small chips of uniform size are almost mandatory to prevent auger plugging. Significant quantities of slivers, chunks, or foreign material can cause auger failure. The least cost chippers are steel frame mounted without their own power source. These units are frequently driven by the power take-off drive from a farm tractor. Wood feed rates to the machine are uncontrolled (hand fed). Chips created are of uneven size and include slivers and chunks. Ease of blade removal for sharpening, maximum size log accepted for chipping, through put rate, etc. are other factors affecting price. Uniform chips are generally best created by a machine that has a feed rate that is machine controlled in some fashion such as by motor driven feed roller jaws to grasp the log and ingest it at a fixed speed. The chipper priced in the table is a fully self-contained unit, complete with power source, trailer mounted ready to roll, and features a controlled feed rate for uniform size chip production.

Cheaper machines can be used successfully, but require careful and constant operator attention to create uniform chip size.

Table 5.6/1 WOOD HARVESTING EQUIPMENT

#	DESCRIPTION	COST
1	1984 GMC - 7000 Series "5 Ton" cab & chassis - single axle - 366 c.i.d. gasoline engine - 14 ft. flat deck wood floor - lights, flaps, headache rack	$29,000.00
2 a)	1984 GMC - 7000 Series, 30,000 GVW cab & chassis - dual axle - 417 c.i.d. gasoline engine - dual gas tanks - 18 ft. flat deck wood floor - lights, flaps, headache rack	41,000.00
b)	added cost to 2 a) to add a hydraulic dump hoist and a light steel box	4,500.00
3	Flat Bed Pintle Hitch Trailer - steel deck 8' wide x 10' long - two 7,000 lb. axles - stake pockets, skirt	8,300.00
4	Chain Saws	
a)	STIHL or Homelite, 16" bar typical	500.00
b)	Repair kit: - bar - chain, file - once per 200 hours	75.00
5	Uniform Chip Size Wood Chipper	
a)	Olathe Model 982 - gasoline engine drive - trailer mounted - 42" flywheel - 12" dia. log feed @ 60 ft/min. - blade sharpening jig - F.O.B. Rae Edzo	22,800.00
b)	Replacement blades	200.00/set

6.0 ECONOMIC VIABILITY ASSESSMENT

6.1 GENERAL

The capital costs to convert a number of specific municipal, institutional and commercial buildings, groups of buildings, and residential dwellings were assembled in Section 5.0. These costs are integrated in this section with incremental operating costs projected for the converted installations to yield a measure of the economic viability of each opportunity.

The net present value of the conversion investment is computed in each case. The effects of inflation, or so called nominal cost increases are not folded into the present value calculations. The cost of wood fuel is therefore assumed to remain constant in real terms, labour costs are similarly held constant in real terms.

The discount rate used reflects the real cost of capital (adjusted net of inflation) as opposed to the nominal cost (encompassing inflation expectations). A real discount rate of 8% per annum is assumed. The cost of fuel oil is assumed to increase in real terms at the rate of 3% per year. The cost of replacement parts for maintenance are assumed to remain constant in real terms.

The wood fuel heating value used in the computations for the substitution of fuel oil for wood fuel is based on the use of jack pine. The gross or as fired heating value for air dried jack pine (16.67% moisture content, wet basis) is 21.6 million BTU/cord (Reference 11) or 6.33 gigajoules per stacked m^3. Jack pine with a 30% moisture content (w.b.) has a heating value of 18.15 million BTU/cord.

The present cost of heating fuel oil is chosen to be $0.40 per litre.

6.2 WOOD FUEL COSTS

The present price for wood fuel in the community is $70 per cord. The price includes delivery of 1, 2, or 3M long whole logs to the purchasers site. Purchasers generally cut and split their own logs to stove size pieces. Wood fuel consumed in the community is principally jackpine, taken from a recently fire killed area approximately 25 km southeast of Rae known as the Mosquito Creek burn. Details of the fuel wood inventory at this location are reprinted in Appendix 5 from a recent DIAND survey.

The costs to harvest wood on a sustained and commercial basis are assembled in this section. The capital costs on assets employed are taken from Table 6.2/1. The costs assigned for the use of these assets are

a) an annual depreciation expense, amounting to 20% of the purchase price of the equipment

b) all operating and maintenance costs

A 20% straight line depreciation allowance was simple to use and was considered to be more realistic of actual costs than depreciation for tax purposes, i.e. 30% declining balance.

A markup to provide a return on investment on capital assets employed, and on the business operation generally, is separately included.

As may be expected, the synthesized cost for wood fuel (Table C.2/1), based upon the use of reasonable business expectations does not match prices that may be found in the market place from time to time dictated by sporadic demand. For example, casual operators have sold wood, cut and stacked in the wood lot ready for loading, for $25 - $30 per cord. However, the operator has likely made no investment in cutting trails, is not committed to a systematic harvesting plan, possibly declines to report stumpage and pay depletion charges, and is not clearly aware of the true picture of his costs.

The final sales prices for log wood fuel, suggested for sustained commercial operations are computed in Table 6.2/2 to be $78.38/cord for a 2,000 cord/year scale of operations; $72.72/cord for a 4,000 cord/year scale of

operations. Wood chips should sell for $80 - $90 per equivalent cord. The table 6.2/2 figures are used in this section as the basis for viability calculations.

The concept used to estimate fuel harvesting costs assumed a low mechanized approach consistent with the desire for employment in the community and with wood lot conditions. Tree felling is done manually using chainsaws. Trees are delimbed and cut into lengths suitable for carrying or dragging by wood handlers to loading points at access points or along trails cut through the woodlot. A pattern of trails totalling about 8 km. in length per sq. km. in woodlot area is assumed.

At the loading points, log fuel is manually loaded onto a flat deck truck and trailer. The loaded truck and trailer are driven from the woodlot to the community where deliveries are made directly from the truck to customers sites. The driver and a helper offload the purchased quantity and collect for the sale.

Chipped fuel is created at the log loading points. A trailer mounted chipper is set-up and logs fed to the unit from the adjoining stock pile. Chips are blown directly into the dump box of a 30,000 lb. GVW transport vehicle for conveyance to the customer. The whole truck load is generally hydraulically dumped at one customer site. The costs estimated for chip fuel assume full load delivery of partially dried wood chips. No carrying costs for wood drying were assumed for the wood harvestor business. i.e. significant stacked log drying time was not factored into the operations.

Table 6.2/1 WOOD HARVESTING COSTS

	SCALE OF OPERATION (per annum) 2,000 cords	4,000 cords
Average Work Day Harvesting Rate (assume 180/year)	11.1 cords	22.2 cords

ITEM	C O S T S	
1. Fuelwood Resource Depletion Charges ("Stumpage") - .05 $/m^3	$ 360.00	$ 720.00
2. Allowance for Reforestation - no imposed requirement - generally no action taken	-o-	-o-
3. Allowance for Winter Roads, Cutting Trails, etc. - $1,000/km, forestry suggested budgetary cost	8,000.00	16,000.00
4. Felling(1) - fell, delimb, cut into totable lengths - 6 cords/saw operator/day	37,300.00	74,600.00
- O & M Costs: saws complete	1,000.00	2,000.00
parts	1,000.00	2,000.00
fuel & oil (6 litres/day)	1,400.00	2,800.00
5. Tote to Loading Point - 3/4 cord per man-hour	22,700.00	45,400.00
SUB TOTAL 1 - 5	$ 71,760.00	$143,520.00
COST PER LOAD	$ 35.88	$ 35.88
Assets Employed in Activities 1 - 5		
- chainsaws - $500.00 each	2	4
- bulldozer - contracted	12 days	24 days

Table 6.2/1 (Continued)

ITEM	COSTS $/cord	COSTS $/cord
6. Whole Log Delivery		
- 3 cords/hr.	$ 2.85	$ 2.85
- Hauling & Delivery (8 cords/load)		
Labour ($84.00/load)	8.50	8.50
Fuel ($40.00/load)	5.00	5.00
Depreciation on Vehicles		
allow. $10,000/yr/2000 cords	5.00	
allow. $12,000/yr/4000 cords		3.00
SUB TOTAL #6	$ 21.35	$ 19.35
Assets Employed in Activity #6		
- 5 Ton Flat Deck truck ($29,000)		
- 6 Ton Flat Deck trailer ($8,300)		
7. Chip Fuel Delivery		
- Chipping @ 6 cords/hr		
Labour operations	$ 2.33	$
Fuel (10 litres/hr.)	1.10	
Labour Maintenance	2.33	
Depreciation & Repairs		
allow. $6,000/yr/2000 cords	3.00	
allow. $8,000/yr/4000 cords		2.00
- Hauling (6 cords/load)		
Labour ($34.50/load)	5.75	5.75
Fuel ($40.00/load)	6.66	6.66
Depreciation & Repairs		
allow. $11,500/yr/2000 cords	5.75	
allow. $14,000/yr/4000 cords		3.50
SUB TOTAL #7	$ 26.92	$ 23.69
Assets Employed in Activity #7		
- 10 Ton Hydraulic Dump box truck ($45,000)		
- Uniform Chip Size wood chipper ($22,800)		

Table 6.2/1 (Continued)

	SCALE OF OPERATION (per annum) 2,000 cords	4,000 cords
Harvest Operating Cost of Cordwood - 1, 2, 3 m. lengths - delivered Cost Items 1 - 6	$ 57.23	$ 55.23
Harvest Operating Cost of Chipped Wood - delivered Cost Items 1 - 5, 7	$ 62.80	$ 59.55

NOTES:

(1) Labour rates assumed: wages and benefits

Chainsaw Operators	$10.50/hr.
Drivers & Deliverymen	$ 8.50/hr.
Chipper Operators	$14.00/hr.

Table 6.2/2 WOOD SALES PRICE

	SCALE OF OPERATION (per annum) 2,000 cords	4,000 cords
A. Cord Wood		
- Operations Cost of Cordwood	$ 57.23	$ 55.23
- Markup on Operations 20% of operations cost	11.45	11.05
- Administration Costs (1)	3.00	3.00
- Return on Investment on Assets Employed @ 35% Asset Value		
($38,300) x .35 ÷ 2000	6.70	
($39,300) x .35 ÷ 4000		3.44
SALES PRICE PER CORD	$ 78.38	$ 72.72
B. Chip Wood		
- Operations Cost of Chip Fuel	$ 62.80	$ 59.55
- Markup on Operations 20% of operations cost	12.56	11.91
- Administration Costs (1)	3.00	3.00
- Return on Investment of Assets Employed @ 35% Asset Value		
($69,300) x .35 ÷ 2000	12.13	
($70,300) x .35 ÷ 4000		6.15
SALES PRICE PER CHIPPED CORD	$ 90.49	$ 80.61

NOTES:

(1) Administration Costs of $3.00 per cord are arbitrarily assigned to allow for business operating costs such as order taking, bookkeeping, invoicing, some working capital financing costs, etc.

6.3 RESIDENTIAL WOOD STOVE INSTALLATIONS

The economic viability of an investment in a residential wood stove installation is computed in this section.

CAPITAL COSTS

The capital costs for a typical installation for a Rae Edzo domestic dwelling were assembled in Table 5.2/1 to be $2300. A number of optimistic assumptions about labour use and materials may reduce the cost to perhaps $1500, as discussed in Section 5.2.

OPERATIONS AND MAINTENANCE COSTS AFTER INSTALLATION

The principal O & M activities associated with wood stove installations are fuel gathering, fire stoking, ash removal, and chimney cleaning. For this analysis, it is assumed that fuel is purchased and delivered to the dwelling property for a price of $78.38 per cord, as assembled in Table 6.2/2. The quantity of wood fuel used, in substitution for fuel oil is indeterminable, as it is dependent on the habits of the occupants. The viability calculations below are based upon an arbitrary substitution of 2,000 litres of fuel oil by wood fuel per home. Recall from Table 3.2/3 that most homes consume 3300 - 3600 litres of fuel oil per annum. The 2000 litre figure was chosen recognizing that the occupant may not use the wood stove overnight or keep the unit stoked all day every day, if an automatic oil fired back-up source is available. The improvement in economic viability due to increased fuel oil substitution is illustrated in the sensitivity analysis.

As a baseline for analysis, it is assumed that activities such as wood cutting and splitting from pole lengths to stove size is done by the user at no explicit cost. Similarly, fuel stoking, ash removal and annual chimney cleaning are performed by the user at no explicit cost. As alternatives, the effects of subcontracted chimney servicing ($80/yr.) and wood splitting ($30/cord) are examined.

The substitution of wood fuel for oil assumes a fuel oil heating value of 35,030 BTU/litre, and a jack pine fuel heating value of 21.6 million BTU/cord for airdried wood. If the fuels are each burned at the same efficiency in their heating appliances, say 60%, then 1 cord of jack pine wood can be substituted for (21.6 x 10^6/35,030) 616.6 litres of fuel oil.

OPERATIONS AND MAINTENANCE COSTS BEFORE INSTALLATION

The relevant activities here include fuel purchase, chimney cleaning and oil furnace servicing. Since the oil furnace is still in use, albeit at a reduced amount, the costs of burner and chimney servicing are assumed constant before and after wood stove installation, and therefore do not represent an incremental cash flow to this analysis. Fuel oil is priced at 40¢ per litre.

ANALYSIS

For the Baseline Case:

a)	Stove installation capital cost	$2,300.00
b)	Post O & M Costs	
	- Wood fuel purchased: $\frac{2000 \text{ litres}}{616.6 \text{ litres/cord}} = 3.25$ cords	
	jack pine, air dried (16.67% m.c.)	
	3.25 cords x $78.78/cord	254.74
	- fuel splitting, chimney cleaning	nil
c)	Prior O & M Costs	
	- fuel oil 2,000 litres x 40¢/litre	800.00

Therefore, against a capital outlay of $2,300.00 a net cost saving of ($800 - $255) $545.00 is expected. The simple economic payback period for this investment is then 4.22 years.

Using discounted cash flow analysis, with an 8% annual discount rate, a 3% annual fuel oil price escalation, and other assumptions as noted earlier, the cash flow summary and net present value (NPV) resulting from this wood stove investment is listed on the following page.

At the End of Year	Investment Principal Outstanding NPV	Total Fuel Cost Savings NPV
0	$- 2300	$ 0
1	- 1773.2	526.8
2	- 1264	1036
3	- 772.5	1527.5
4	- 298	2002
5	+ 159.7	2459.7
6	+ 600.9	2900.9
7	+ 1026.2	3326.2
8	+ 1435.9	3735.9
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.	.	.

As indicated from this summary, on a discounted cash flow basis, the investment is fully recovered between the end of Year 4 and Year 5.

SENSITIVITY CONSIDERATIONS

The simple economic payback of 4.22 years computed above changes as assumptions about the cash flow and the usage patterns of the wood stove change, as demonstrated by the following examples (in isolation from each other):

a) COSP Grant

If an EMR Canada Oil Substitution Program grant ($800.00 or half the cost) was secured and the dwelling occupant could also reduce the capital costs to $1500 by do-it-yourself labour and shorten chimney requirements etc., the simple economic payback period becomes $\left(\frac{1500 - 750}{545}\right)$ 1.38 years.

b) Wood Moisture Content

If the jack pine fuel used was not air dry (16.67% m.c.) but had a moisture content of 30% (wet basis), the heating value of the wood would reduce to 18.15 million BTU/cord, 3.87 cords would be required in place of 2,000 litres of fuel, and the simple economic payback period would become $\left(\frac{2300}{800 - 303}\right)$ 4.63 years.

c) Amount of Fuel Oil Substituted

If 3,000 litres of fuel oil were substituted by the wood stove, 4.87 cords of air dried jack pine are required, and the simple economic payback period becomes $\left(\frac{2300}{1200 - 381}\right)$ 2.81 years.

d) Subcontracted Services

If the dwelling occupant paid $80/yr. for chimney servicing, and $30/cord for log splitting, the economic payback period would become $\left(\frac{2300}{1800 - 432}\right)$ 6.25 years.

e) Reduced Price of Wood Fuel

If the price of wood fuel was reduced to 70% of the assumed price, or to $54.87 per cord, the payback period becomes $\frac{2300}{800 - 178.56}$ 3.7 years.

Conclusion

The installation of an airtight wood stove into a typical Rae Edzo residential dwelling can result in the saving of 2,000 - 3,000 litres of fuel oil; would consume 3 - 4 cords of wood fuel; and will result in an economic recovery of the capital costs of the installation typically in 4.2 years (1.38 - 6.25 year range). The use of capital funds grants and do-it-yourself labour can reduce the payback period dramatically.

6.4 WOOD FURNACE INSTALLATIONS

The installation of add-on wood furnace equipment, a stand-alone wood furnace, or a new combination wood/oil burning furnace was advocated for certain residential and commercial buildings in the community. Table 5.3/1 indicated that the capital cost for the retrofit installation of any of these types of furnaces is more or less identical. Accordingly, for the purposes of this analysis, a single capital cost is chosen, and one set of calculations are performed to suffice for the three furnace types. Most of this analysis is focussed on residential scale installations. Commercial scale installations are addressed at the end of this section.

CAPITAL COST

The capital costs for the typical installation of a wood furnace appliance into a Rae Edzo commercial or residential application are assembled in Table 5.3/1. Retaining the assumptions noted in the assembly of those costs, the installed cost of a typical installation of $5100 is used in this analysis. As an option, the addition of a furnace stoker is considered at installed costs listed in Table 5.3/1.

OPERATIONS AND MAINTENANCE COSTS OF A WOOD FURNACE

The prinicpal O & M costs in support of a wood furnace include wood fuel purchase, whole log cutting and splitting to stove size, furnace filter replacement, chimney cleaning, and furnace fuel stoking. As a baseline case assume the user buys wood fuel in log form for $78.38 per cord, and performs the other functions at no explicit cost to the operation. As an alternate possibility, explicit costs of $30 per cord for wood splitting and $80 per year for chimney cleaning are considered.

The substitution of 3,000 litres of fuel oil per year by use of the wood furnace is assumed as the baseline case for analysis. This figure is selected somewhat arbitrarily on the premise that a resident will easily substitute 80% of the present fuel oil consumption without much effort or

or dedication to the wood burning equipment. 100% substitution is possible by careful attention to the heating needs of the building at all times.

Installations with wood stoking equipment are also considered. A substitution quantity of 5,000 litres per year is assumed in this case.

OPERATING AND MAINTENANCE COSTS OF OIL BURNING FURNACES

The principal O & M activities to support oil furnaces include fuel purchase, occasional air filter replacement and burner adjustment. Since the oil furnace is retained as a back-up, the only change in cash flow assumed is due to the reduction in fuel oil consumed.

ANALYSIS

For the baseline case:

a)	Wood Furnace installed capital cost - stoker excluded	$5,100.00
b)	incremental O & M costs	
	- wood fuel purchased	
	o $\frac{3{,}000 \text{ litres}}{616.6 \text{ l/cord}}$ = 4.87 cords	
	o jack pine, air dried (16.67% m.c.)	
	o 4.87 cords x $78.38/cord	382.10
	- fuel splitting, chimney cleaning	nil
	- fuel oil cost savings	
	o 3,000 litres x $0.40/litre	(1,200.00)

Therefore, for a capital outlay of $5,100 for a wood furnace installation, an annual net cost saving of ($1200 - $382) $818 per year is expected. The simple economic payback period for this investment is 6.23 years.

Using discounted cash flow analysis, with an 8% annual discount rate, a 3% annual real fuel price escalation, and other cash flow assumptions noted in 6.1, the net present value of the typical wood furnace investment is shown on the following page on a year-by-year basis.

At the End of Year	Investment Principal Outstanding NPV	Total Fuel Cost Savings NPV
0	$- 5,100	$ 0
1	- 4309.3	790.7
2	- 3545.1	1554.9
3	- 2807.6	2292.4
4	- 2095.6	3004.2
5	- 1409.1	3690.9
6	- 747.0	4353
7	- 108.7	4991.3
* 8	+ 506.2	5606.2
9	+ 1098.2	6198.2
10	+ 1668.3	6768.3
11	+ 2216.7	7316.7
12	+ 2744.6	7844.6
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The investment is recovered after approximately 7.2 years, on a discounted cash flow basis.

SENSITIVITY CONSIDERATIONS

The simple economic payback period of 6.23 years is modified by the following considerations.

a) Automatic Chip Fuel Stoker

The installation of a small capacity wood chip fuel automatic furnace stoker (installed cost, $5,000) in larger domestic installations is assumed, and may result in substitution of 5000 litres of fuel oil. The cost of chip fuel is assumed to be $90.49 per equivalent cord. The simple economic payback period due to the addition of this wood fuel stoker and switching to chipped wood fuel is 8.0 years. (An estimated 8.1 cords of wood are required in place of 5000 litres of fuel oil).

b) COSP Grant

An EMR Canada Oil Substitution Program grant of $800.00 would reduce the capital costs of conversion of a basic wood furnace to typically $4,300, resulting in a reduction in payback period from 6.23 years to 5.25 years.

c) Wood Moisture Content

The use of partially wet wood, with a moisture content of 30% (wet basis), as opposed to air dry wood requires 5.8 cords to replace 3,000 litres of fuel oil, instead of 4.87 cords. The increased total wood fuel cost results in an extension of economic payback period to $\frac{5100}{1200 - 454.6}$ 6.84 years, from 6.23.

d) Amount of Fuel Oil Substituted

The cost of the quantity of fuel wood required to replace 1,000 litres ($400.00) of fuel oil is $127.11. Therefore, a decrease in the amount of fuel oil used, in favour of wood fuel, accelerates the payback period of the investment. If 4,000 litres were substituted for wood fuel, the payback period becomes $\frac{5100}{1600 - 508.5}$ 4.67 years; if 2,000 litres were substituted, the payback extends to 9.34 years; 5,000 litres (hand fired) - 3.7 years.

e) Subcontracted Services

If the dwelling occupant paid $80 per year for chimney servicing, and $30 per cord for log splitting, an installation saving 3,000 litres of fuel oil per year (4.87 cords of wood used) has a simple economic payback period of 8.6 years.

f) Reduced Wood Fuel Prices

If wood fuel prices were reduced to 70% of assumed values, or $54.87 per cord, the payback period would become $\frac{5100}{1200 - 276}$ 5.5 years.

COMMERCIAL APPLICATIONS

The preceding economic analysis focussed upon the installation of wood furnace equipment in residential applications. In commercial installations, the fuel oil consumption quantities are higher, but some form of automated wood fuel feed system is generally preferred. In the case of the Rae Hudson's Bay Store, the capital cost for a suitably sized wood fired hot air furnace and a 10 m^3 chip storage silo with auger out feeder is approximately $25,000 installed. The store portion of the Hudson's Bay annual fuel use is approximately 16,000 litres per annum. The operating cost savings due to the use of wood fuel are:

- wood fuel cost:

  $\frac{16,000 \text{ L.}}{616.6 \text{ L/cord}}$ = 26 cords

  26 cords x $90.49 = $2,353

- fuel oil savings:

  16,000 L. x $.40/L. = $(6,400)

  NET SAVINGS $(4,047)

The simple economic payback period for this investment is 25,000 ÷ 4047 = 6.2 years. If $1,000 per year is added to operating costs for chimney cleaning and equipment servicing, the payback period is extended to 8.2 years.

Conclusion

The installation of a wood furnace into a typical Rae Edzo residential dwelling may result in the saving of 3,000 - 5,000 litres of fuel oil per year and an economic payback period in the range of 3.7 - 7.5 years. The addition of an automatic wood chip fuel stoker to the furnace may increase the total fraction of wood energy used to 100%, but the increased cost of chips over wood in whole log form results in a net extension in economic payback period for a domestic user who would otherwise split wood on his own. For the commercial operator who would pay extra for splitting wood, and who must tend to the furnace at times when the business is closed or else fall back to use of the oil furnace, the automated chip fuel stoker is technically preferred and economically attractive.

6.5 WOOD BOILER INSTALLATION

Four boiler installations were described in Section 5.0 as possible candidates for conversion to wood fired heating equipment. The installations were considered at the Nishi Khon Centre, Jimmy Bruneau School, the Cottage Hospital, and the new Hamlet Garage. The economic viability of these installations are addressed in this section.

CAPITAL COSTS

The estimated capital costs for a suitable installation of wood boiler euqipment, wood fuel stoker and fuel storage hardware for each building were assembled in Tables 5.4/1 and 5.4/2 to be: $139,100 for the Nishi Khon Centre; $152,500 for the Jimmy Bruneau School; $45,450 for the new Hamlet Garage; and $53,550 for the Cottage Hospital.

OPERATIONS AND MAINTENANCE COSTS OF A WOOD BOILER

Operations and maintenance activities for a wood boiler include: fuel feeding, boiler cleaning, ash removal, annual dissassembly for GNWT Safety Division inspection, daily monitoring of performance and periodic adjustment of output controls. Continuous supervision of a wood boiler heating unit is not required.

Fuel feeding is the task of loading the wood storage bin or silo with wood chips, stockpiled on the premises to dry. The task can be incorporated into the tasks of existing staff or tenants in the building, or can be contracted separately. An ongoing operating cost of $10 per cord is charged to the wood boiler operations to allow for the hiring of periodic casual wood handlers to reload the fuel bins, later unloaded by automatic stoker equipment. A further charge of 3% of the value of the wood purchased in a season is levied to recognize the cost of holding a wood supply an average of 3 months from date of purchase to date of use, in order for the wood to dry.

The value of $10 per cord, plus 3% could alternately be paid to a wood harvester if the harvester inventories wood in the woodlot until air-dried, and delivers dry chips directly to the stoker supply bin. The $10 per cord could also be paid to a student for an after school and weekend parttime job to manually refill the supply bin from the owners storage. Larger jobs requiring a small "Bobcat" sized loader may represent a business opportunity for a local entrepreneur. In any case, a charge of $10 per cord for wood loaded into the supply bin is levied.

The time required for ash removal from the flue gas cyclone scrubbers, or from the boiler fire box is considered to be negligible and no explicit costs are recognized. Ashes are disposed as part of the community's dry garbage collection system. No additional costs for garbage collection services were estimated for this action.

Daily boiler performance monitoring and controls adjustment are presently duties of the responsible building supervisor. No additonal costs due to the substitution of a wood boiler for an oil fired boiler are recognized.

Boiler cleaning and annual inspection activities are additional duties for a wood boiler, when an oil fired unit is retained for back-up. If a day shift boiler operator is already employed, these duties can be accommodated within present workloads without an explicit extra cost to the wood boiler. In cases when no attendant presides (Cottage Hospital, Equipment Garage), the costs to do boiler and chimney cleaning and annual inspection work are explicitly estimated.

The quantity of electricity used by a wood boiler exceeds the amount used by an equivalent sized oil fired unit. The extra electricity is used in the fuel augering system and by the larger fan motor used to sustain proper draft in the wood boiler fire box.

OPERATING AND MAINTENANCE COSTS OF OIL FIRED BOILERS

The oil fired equipment is assumed to be retained for standby service. The incremental operating cost savings realized by switching to wood are assumed to be only due to the savings in fuel oil. Existing heating plant operators remain employed. Major servicing of the oil fired units, e.g. burner adjustments, annual breakdown for cleaning and inspection, etc., are asusmed to continue as before.

ANALYSIS

For the baseline case:

	Nishi Khon Centre	J. Bruneau School	Cottage Hospital	New Equip't Garage
a) Installed Capital Cost	$139,100	$152,500	$53,550	$45,450
- capacity inst'd	1.5 million BTU/hr.	5.0 million BTU/hr.	401,700 BTU/hr.	401,700 BTU/hr.
b) Incremental Operating and Maintenance Cost				
* amount of fuel replaced (assume 95% of present consumption is replaced)	38,000 Litres (est)	218,500 Litres	43,215 Litres	28,000 Litres (est)
* equivalent amt. of wood fuel (airdried jack-pine) 616.6 L. = 1 cord	62 cords	354 cords	70 cords	45 cords
1. Cost of Wood Fuel				
$90.49/chpd cord	$ 5,610	$32,033	$ 6,334	$ 4,072
$10/cord loading	620	3,540	700	450
3% holding cost	168	961	190	122
2. Added Costs of Cleaning & Servicing				
* present operators duties	nil	nil	nil	nil
* no operator presently employed			1,000	1,000
3. Electricity				
$0.18 per kwh	1,300	6,000	1,600	900

	Nishi Khon Centre	J. Bruneau School	Cottage Hospital	New Equip't Garage
4. Value of Fuel Oil Saved + 40¢/litre	$(15,200)	$(87,400)	$(17,286)	$(11,200)
NET ADDED O & M COST (SAVING)	$(7,502)	$(44,866)	$(7,462)	$(4,656)

The net operating cost savings created by the installation of wood boiler equipment are estimated to be $7,502 for the Nishi Khon Centre; $44,866 for the J. Bruneau School; $7,462 for the Cottage Hospital; and $4,656 for the Hamlet New Equipment Garage. Based on the capital costs incurred the simple economic payback period for investments in wood boiler equipment, in each case are:

18.5 years for the Nishi Khon Centre
3.9 years for the J. Bruneau School
7.17 years for the Cottage Hospital
9.76 years for the new Hamlet Equipment Garage.

Using discounted cash flow analysis, with the same assumptions for discount rate and fuel oil cost rise etc., as documented in earlier subsections, the net present values of wood boiler investments in each of the facilities are as tabulated below.

NISHI KHON CENTRE

At the End of Year	Investment Principal Outstanding NPV	Total Fuel Cost Savings NPV
0	$- 139,100	$ 0
1	- 131,732	7,368
2	- 124,504	14,596
5	- 103,767	35,333
10	- 72,555	66,545
15	- 45,655	93,445
20	- 22,858	116,242

NISHI KHON CENTRE (Continued)

At the End of Year	Investment Principal Outstanding NPV	Total Fuel Cost Savings NPV
25	$- 3,857	$ 135,243
26	- 456	138,644
27	+ 2,808	141,908
28	+ 5,953	145,053
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Investment recovered after 26.3 years.

J. BRUNEAU SCHOOL

At the End of Year	Investment Principal Outstanding NPV	Total Fuel Cost Savings NPV
0	$- 152,500	$ 0
1	- 108,530	43,970
2	- 65,480	87,020
3	- 23,421	129,079
4	+ 17,602	170,102
5	+ 57,604	210,104
6	+ 96,559	249,059
.	.	.
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.	.	.

Investment recovered after 3.6 years.

COTTAGE HOSPITAL

At the End of Year	Investment Principal Outstanding NPV	Total Fuel Cost Savings NPV
0	$- 53,550	$ 0
1	- 46,161	7,389
2	- 38,859	14,691
3	- 31,665	21,885
4	- 34,589	28,961
5	- 17,639	35,911
6	- 10,824	42,726
7	- 4,151	49,399
8	+ 2,372	55,922
9	+ 8,739	62,289
10	+ 14,949	68,499
.	.	.
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Investment recovered after 7.7 years.

NEW HAMLET EQUIPMENT GARAGE

At the End of Year	Investment Principal Outstanding NPV	Total Fuel Cost Savings NPV
0	$- 45,450	$ 0
1	- 40,828	4,622
2	- 36,200	9,200
3	- 31,731	13,719
4	- 27,278	18,172
5	- 22,896	22,554
6	- 18,593	26,857
7	- 14,374	31,076
8	- 10,244	35,306

NEW EQUIPMENT GARAGE (Continued)

At the End of Year	Investment Principal Outstanding NPV	Total Fuel Cost Savings NPV
9	$- 6,208	$ 39,242
10	- 2,267	43,183
11	+ 1,573	47,030
12	+ 5,317	50,767
.	.	.
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.	.	.

Investment recovered after 10.6 years.

SENSITIVITY CONSIDERATIONS

As demonstrated by the analysis, the economic payback period is influenced by the assumed capital costs, the actual quantity and price of fuel oil substituted, the price and quantity of wood use, labour related operating costs, etc.

a) Fuel Oil Quantity
If the actual fuel oil quantity used prior to conversion was 10% higher than reported, the payback period would be 10 - 12% shorter than computed in the baseline case.

b) If jack pine wood fuel with a moisture content of 30% (wet basis) was burned instead of air dried chips (16.67%) the heating value of the wood is reduced by 15% (518.1 litre = 1 cord). The simple economic payback period is extended by 25%.

c) Capital Costs of Conversion
The economic payback period is directly related to project capital costs. A 20% reduction in project capital costs due to receipt of a grant, or reduced installation costs, equipment costs, etc. results in a 20% reduction in payback period.

d) Increase in Operation Costs

The viability of the investments are very sensitive to annual operating expenses. A $5,000 per year added charge due to addition of more part-time help than presently budgeted for could completely destroy project economic viability in certain cases.

A summary of the sensitivity of project economic viability to various costs and factors is presented in Table 6.5/1.

Table 6.5/1 SENSITIVITY OF SIMPLE ECONOMIC PAYBACK PERIOD

SENSITIVITY FACTOR	PAYBACK PERIOD			
	Nishi Khon Centre	J. Bruneau School	Cottage Hospital	New Equipt Garage
Baseline Case	18.5 yrs.	3.4 yrs.	7.17 yrs.	9.76 yrs.
a) 10% increase in fuel oil now used over amount reported	16.5	3.0	6.3	8.6
b) 20% increase in fuel oil	15.0	2.8	5.6	7.6
c) 20% reduction in capital costs for the conversion	14.8	2.7	5.7	7.8
d) $5,000 increase in misc. annual operating costs	55.6	3.8	21.75	infinity
e) use of 30% moisture content wood chips	22.0	4.0	8.9	12.3
f) wood fuel reduced to $63.34 per chipped cord (70%)	15.1	2.8	5.7	7.7

CONCLUSION

The economic viability of a wood fired boiler at the J. Bruneau School appears to be excellent. The viability of retrofit installations at the Cottage Hospital, and the new Hamlet Equipment is fair to good.

The viability of a wood fired boiler retrofit at the Nishi Khon Centre appears to be poor. However, there is suspicion that the viability analysis may be incorrectly posed, or based on unfactual data. The relationship between the installed boiler capacity and the reported amount of fuel oil used is substantially different for the Nishi Khon Centre than for the other boiler systems investigated (see the preceeding analysis). It is suspected that either the installed boiler capacity (and hence the substituted wood boiler) is significantly oversized for the load, or the fuel oil quantity reported is much less than actually consumed. An oversized boiler implies an excessive capital cost. A low reported oil consumption implies too little in operating savings. It is suggested that the Nishi Khon Centre operating staff carefully monitor the boiler system loading in the next winter season and the actual fuel oil quantity consumed. The wood boiler viability analysis should be re-computed after that time, based upon a more thorough assessment of the required size of a wood boiler, and highly accurate fuel consumption data.

Reviewing the sensitivity table generally, it is clear that economic viability is extremely dependent upon the annual operating costs of the wood boiler facility. The addition of an extra operator for example, where one did not exist before, would completely ruin the economic viability of all candidate installations except perhaps the J. Bruneau School prospect.

6.6 CENTRAL WOOD BOILER INSTALLATIONS

Centralized or district heating systems serving a number of building loads were described in Section 5.5. Capital costs for three installations were assembled; the Nishi Khon area; residential dwellings district heating system; and the RCMP facilities central heating system.

The viability of each proposed installation is addressed, in turn, on the following pages.

6.6.1 Nishi Khon Area

The viability of a wood boiler for the Nishi Khon Centre complex only is examined in the previous section. The capital costs to separately tie-in three additional loads were assembled in Table 5.5/1. The loads were the proposed new Old Folks Home ($73,500) the Adult Education Centre ($20,500) and the Hamlet Workshop ($47,800). The additional operating costs sustained in connection with the three add-ons primarily include costs to pump hot water to the loads. No increase in costs for a boiler operator are included. The existing arrangements for attending the present Nishi Khon Centre oil fired boiler equipment are assumed to prevail for the substitution of a 1.5 - 2.5 million BTU/hr. wood boiler. Labour to stoke the wood fire is costed on a per cord basis as per the discussions in Section 6.5.

Sensitivity Considerations

The sensitivity to economic viability of this installation as a consequence of various factors has been demonstrated in Table 6.5/1.

ANALYSIS

For the Baseline Case: Nishi Khon Centre plus:-	All Additions	(1) Old Folks Home Addition Only	(2) Adult Education Centre Addition Only	(3) Hamlet Workshop Addition Only	(2) plus (3) Only
a) Total Installed Capital Cost - see Table 5.5/1	$292,900	$224,600	$159,600	$186,900	$207,400
b) Additional Operations and Maintenance Costs					
- Total amounts of fuel oil replaced (assume 95% of present consumption is replaced)	88,000 L. est.	62,000 L. est.	49,000 L. est.	53,000 L. est.	64,000 L. est.
- Equivalent amount of wood fuel • 616.6 L. = 1 cord (air dried jack pine) • allow extra 10% for distribution losses to Old Folks Home	143 cords	111 cords	80 cords	86 cords	104 cords
1. Cost of Wood Fuel					
- $90.49/chipped cord	$ 12,940	$ 10,044	$ 7,239	$ 7,782	$ 9,411
- $10.00/cord loading	1,430	1,110	800	860	1,040
- 3% holding cost	388	301	217	233	282
2. Added Costs of Cleaning and Servicing - over present oil fired installation - absorb into present operation duties	--	--	--	--	--
3. Electricity ($0.18 kwh)	3,200	3,200	1,300	1,300	1,300
4. Value of Fuel Oil Saved (40¢/Litre)	(35,200)	(24,800)	(19,600)	(21,200)	(25,600)
NET O & M COST (SAVING)	$(17,242)	$(10,145)	$(10,044)	$(11,025)	$(13,567)
Simple Payback Period on Investment	17.0 years	22.1 years	15.9 years	17.0 years	15.3 years

Conclusions

The simple economic payback period associated with these central heating system options are in most cases better than the 18.5 year payback on the Nishi Khon Centre building on its own. The arrangement to heat the Nishi Khon Centre, the Adult Education Centre, and the Hamlet Workshop from one centrally located boiler plant is the most viable of the configurations possible. A decision to dismiss this candidate for wood boiler conversion should not be made until the Nishi Khon Centre operations have been further scrutinized, as discussed in Section 6.5 - Conclusions.

6.6.2 Residential Dwellings Heating System

A central heating system to serve 25 homes in Rae is considered. The capital costs for a central plant and main distribution lines were estimated to be $492,500 (Table 5.5/2). The tie-in costs for each of the 25 homes were estimated to be typically $22,800 per home. The economic viability fo the central system, serving 25 homes is calculated below. The marginal economic viability of adding additional houses to the central system is estimated in the following analysis also.

ANALYSIS	25 Homes	30 Homes
a) Installed Capital Cost		
- 4.0 M BTU/hr boiler plant 4.75 BTU/hr	$162,500	$173,500
- Distribution Mains	330,000	396,000
- Dwelling Tie-In Costs	570,000	684,000
b) Operating and Maintenance Costs		
- Amount of fuel oil replaced • assume 4700 litres/house	117,500 L.	141,000 L.
- Amount of wood fuel required • assume 616.6 L. = 1 cord (air dried jack pine) • allow extra 20% for distribution losses	229 cords	275 cords
1. Cost of Wood Fuel		
- $90.49/chipped cord	$ 20,722	$ 24,885
- $10.00/cord storage bin loading	2,290	2,750
- 3% holding cost	622	746
2. Maintenance Services - routine cleaning, adjustment - 40 hr./week boiler supervision - assume one qualified operator	34,500	34,500
3. Electricity ($0.18/kwh) - for boiler operation - for hot water distribution	12,000	13,400
4. Value of Fuel Oil Saved (40¢/litre)	(47,000)	(56,400)
NET ADDED O & M COST (SAVING)	$ 23,124	$ 19,881

Conclusion

The concept to heat a number of residential dwellings from a central wood fired heating system is economically not viable. The net operating costs of the centralized sytem, retaining oil fired back-up equipment, exceed the present costs to operate individual dwelling oil furnaces as a primary heat source.

One main reason for the economic failure of this concept is the requirement to hire an operator for the central boiler plant operation. A second reason is, clearly, the capital costs for the main distribution system are very large and the loads to be tied-in total less than the J. Bruneau school on its own.

6.6.3 RCMP Facilities

A centrally located wood boiler heating system was conceived for heating the various RCMP building near the detachment office in Rae. A low cost proposition was conceived whereby an existing structure is used to house the boiler, and existing utilidor is used to enclose the to-be-installed heat transmission lines. The boiler possibly suitable is a unit of approximately 20 b.h.p. (670,000 BTU/hr., 196 kw) in size. It is anticipated that members of the RCMP can quickly learn the operation of this small boiler, and will supervise the operation of the unit without the need for hiring a new staff member. The capital costs for a wood boiler installation with automated fuel stoking equipment are assembled in Table 5.5/3 to be $93,450, plus an additional $32,800 to tie-in the NCO house.

ANALYSIS	N.C.O. HOUSE Included	Excluded
a) Installation Capital Cost	$ 94,350	$126,250
b) Added Operating and Maintenance Costs - assume oil furnaces retained as backup		
- amount of fuel oil replaced (assume 95% of present consumption is substituted)	33,500 L.	42,500 L.
- amount of wood fuel required 616.6 L. = 1 cord (air dried jack pine) allow extra 3% for distribution losses	56 cords	71 cords
1. Cost of Wood Fuel		
- $90.49/chipped cord	$ 5,067	$ 6,425
- $10.00/cord loading the fuel silo	560	710
- 3% holding cost	152	193
2. Seasonal Cleaning & Inspection (subcontracted)	$ 1,000	1,000
3. Electricity ($0.18/kwh)	1,100	1,300
4. Value of Fuel Oil Saved (40¢/L.)	(13,400)	(17,000)
NET ADDED O & M COST (SAVING)	$(5,520)	$(7,372)
Simple Economic Payback Period on the Capital Invested	16.9 years	17.1 years

Conclusion

The economic viability of this central heating arrangement is tenuous. An increase in moisture content of the wood fuel burned to 30% w.b. increases the 16.9 year payback up to 21.1 years. The economics are also based on the detachment officers taking charge of the general supervision and routine operation of the wood boiler unit. This may be difficult to achieve in practice.

7.0 COMMUNITY ISSUES

7.1 GENERAL

A wide spread conversion program not only must be justifiable on economic grounds, but also must be consistant with the wishes of the community, and consistant with the capabilities of the community to undertake or assimilate the activity. This section addresses the various community issues that must be supportive of a major wood conversion initiative.

Community support for the increased use of wood heating fuel is substantial. Business leaders, hamlet leaders and private citizens all welcome the increased opportunities for employment for community residents in the wood harvesting and distribution activities. During discussions with community residents considerable interest was expressed in learning about the capabilities and performance of modern wood burning appliances, particularly residential equipment. Questions were often posed about what are good brand names to buy and what are good features to look for. This level of interest provided the impetus for this study team to create a catalogue of wood burning equipment product literature (referred to elsewhere in this report) for the use and benefit of the community.

The elder citizens in the community are well experienced with heating with wood fuel and some view a return to wood fuel as a positive step in returning to living from the land and self-reliance. Many older people prefer to cook their meals on a wood cookstove. Their food preparation habits were developed on a wood stove and some do not like gas or electric range cooking or feel unconfident in using these types of appliances.

The community trend is toward an increase in private ownership. As income and education levels rise, and as residents do business in the modern NWT economy, the desire for financial independence, and home ownership have increased. People wish to have wealth to pass on to succeeding generations. This pride in ownership, and consequent increase in ownership, has fostered in increased sensitivity to the costs of heating a

dwelling with fuel oil. A fully developed wood heating infrastructure, plentiful community knowledge on good quality wood burning equipment, and a well developed, planned, long term wood fuel supply source are welcomed by these new or prospective home owners.

The community of Rae Edzo is not immune to power outages. Two or three day winter season outages have occurred in the last couple of years, and partial day outages are fairly common throughout each winter. Since oil furnaces, furnace controls, and blowers are inoperative during these periods, plumbing damage from freezing is possible, and personal discomfort is a certainty. The availability of a wood fired appliance in a dwelling or small commercial building was referred to by residents as a desirable back up heat source during power outages. (Of course, larger wood boiler systems require electricity to function.)

The approach to wood harvesting favored by residents was the status quo. Private own-use wood cutters, small scale commercial or cottage industry cutters, and larger commercial wood cutters should be able to secure wood from the wood lots.

7.2 SKILLS

REQUIREMENTS

The skills required in the community to support the wide spread institutional, municipal, commercial, and residential use of wood fuel include:

- o wood harvesting
  - chain saw operation and maintenance
  - chipper operation and maintenance
  - truck driving and safety
  - heavy equipment operation

- o equipment installation
  - sheet metal fabricators
  - electricians
  - plumbers and pipefitters
  - carpenters
  - heavy equipment operators

- o equipment operation and maintenance
  - boiler operators
  - wood fuel handlers and fuel stokermen
  - chimney cleaners
  - boiler cleaners

AVAILABILITY

The skills indicated to accomplish wood harvesting are plentiful in the community, except for chipper operations and maintenance. Many citizens own chain saws and operating and servicing skills are probably more plentiful than driver's licences.

Light duty trucks are the predominant type of vehicle in the community. The rate of vehicle ownership per family is lower than for larger communities or southern communities, but access to a vehicle to haul wood for

personal use is not too difficult in exchange for giving away part of the harvest. Four local entrepreneurs were identified as in the business to harvest and sell fuel wood under contract. Two or three of the contractors have bid on 800 cord per year contracts and have the trucks, trailers and other equipment to handle the workload. A major shortage of wood hauling equipment does not appear to exist. Others could enter the major contract marketplace with the purchase of readily available trucks and trailers in Yellowknife or northern Alberta.

Bulldozer, loader, motor grader heavy equipment and operators are available variously through the Hamlet, local contractors or Yellowknife contractors. Suitable equipment to assist with wood lot access trail clearing is available in the region.

No wood chipping equipment or wood chipper operating and maintenance experience exists in the community. Chipped fuel will predominantly be required by the larger institutional buildings, and as such will likely be supplied under contract to the facility. Various scenarios for procurement of a chipper are possible. A unit can be purchased by the Hamlet for the benefit of the community, by the institution requiring the chip fuel, or by an entrepreneur in the wood supply business.

Equipment installation trades are not plentiful in Rae Edzo. The required services are available in Yellowknife. Some electrician and carpentry skills exist in Rae Edzo. The tradesmen are recognized as competent in residential construction. Their trades certifications are unknown. The duration of the installation phase of a conversion program would not sustain the apprenticeship training of a trade skill. However local persons could become competent to do most aspects of the stove and furnace installations in a reasonably short time.

Sheet metal fabrication services would be secured from Yellowknife.

The Rae Edzo Housing Association employ a housing maintenance crew. Crew members typically have completed a 4 year Home Maintenance Skills

Training Program (apprentice program, 8 wks. of classes per year). The Home Maintenance program teaches fundamentals in electrical, plumbing, carpentry trades and oil burner servicing.

Skills to operate wood burning boiler equipment are not plentiful in the community. The NWT Boiler and Pressure Vessels Ordinance prescribes the training required for an operator of boiler equipment in the NWT. The Ordinance makes no distinction in qualifications or degree of supervision for tending a wood fired boiler as opposed to an oil fired unit. Assuming that present oil fired boiler installations are tended by suitably qualified staff, substitutions of wood fired boiler units will be straight forward. The nuances of the wood fired units will be quickly grasped by the qualified operator. The creation of wood fuelled district heating systems will require the training of qualified operators.

Those persons presently responsible for domestic or commercial oil furnaces can be expected to become proficient supervisors of substitute wood burning equipment in a short time without difficulty. The furnaces are controlled automatically except perhaps for wood fuel feeding. A community presentation or workshop on wood appliance operation and safety is advocated in the conversion plan to provide residents with the necessary grasp of wood burning fundamentals and appliance operations.

Wood stove or furnace fuel stoking and chimney cleaning for residential installations are easily mastered. Commercial installations may choose to pay a casual labourer to do chimney cleaning. Larger municipal or institutional chipped fuel installations are assumed to have automated feed systems. Depending on the approach used to dry the fuel the chips can be directly unloaded into the silo or bin storage of the automatic stoker. The minimum hauling of the fuel (and consequently least cost) is achieved if the wood is air dried in whole log form. The chipping of green wood and stockpiling in the woodlot or at the users site to dry precipitates a second wood pick-up operation, likely using a front end loader, and results in higher operating costs. In any case the skills associated with this job are not expected to be scarce.

Boiler and chimney cleaning for larger installations are tasks generally assigned to the attending boiler operator.

TRAINING REQUIRED

Little training is required to upgrade the community to successfully undertake a wide spread wood conversion program.

In connection with wood harvesting operations, training in chipper operations and maintenance is required. Proper operating practices and prudent maintenance activities should not be underestimated. An operator can become proficient in these areas in perhaps one week of hands on experience, supervised by a capable operator or carefully instructed by the equipment vendor. Proper training will permit rapid cutting blade replacement, good quality blade sharpening skills, uniform chip production, and careful chipper unit servicing to maximize its lifetime.

Training for the efficient operation and servicing of wood stoves and furnaces by their owners may most effectively be delivered by a public workshop on proper operations, safety, and efficiency factors.

Training for boiler operators for new district heating systems is the most extensive training need for the community. The combined classroom and on-the-job training requirements for certified operators vary with the size of plant operated and are set out in the NWT Boilers and Pressure Vessels Ordinance.

7.3 COMMUNITY INFRASTRUCTURE

Elements of the community infrastructure dealing with equipment and skills availability have been discussed earlier. Wood harvesting and delivery to users can be accomplished through existing businesses and operators. Operations and maintenance activities can be handled in most cases except where formally trained boiler operators for new installations are required. The community does not have a developed infrastructure of installation trades and will have to draw upon the resources of Yellowknife.

The community does not have a sales or distribution outlet to sell residential wood burning appliances. Purchase advice, opportunity to view and inspect various product lines, and other sales outlet supplied services are not available to local people. Sales outlets for residential wood burning appliances do exist in Yellowknife and Hay River. Sales and distribution outlets for automated wood stokers and commercial sized wood boiler systems are not available in the NWT.

Disposal of wood ashes from the boilers, furnaces and stoves can probably be handled through the community's present dry garbage collection and disposal program, according to Hamlet officials. Present users of wood fuel dispose of ashes in this manner. Dry garbage is presently collected twice per week in the community in winter months (three times per week in the summer). The collection truck and service is supplied under contract to the Hamlet by a local entrepreneur. Garbage is disposed in a landfill site southeast of Rae.

There appears to be no significant community infrastructure barriers to the success of a wide sp[illegible]d wood conversion program.

8.0 CONSTRAINTS TO WOOD CONVERSION

8.1 GENERAL

The economics of wood conversion are attractive in a variety of circumstances, as presented in Chapter 6.0. However, other factors must be favorable to the conversion activity before a particular conversion project will actually take place. Factors that impede or constrain the widespread adoption of wood fuelled heating systems in the Rae Edzo community are discussed in this section. Solutions to these constraints are suggested in certain cases.

A number of potential concerns initially identified have proven to be insignificant. The GNWT has an adequate quality control program for the construction of new housing. The Department of Justice and Public Services, Safety Division enforces construction and building operations related ordinances based on Canadian National Building Code standards, CMHC standards, ASME pressure vessel codes, and other popular standards applied throughout Canada. The Safety Division encourages the installation of wood burning appliances in accordance with the guidelines published by CMHC (ref. 16). Accordingly, the provisions of the local building codes and safety regulations do not represent a barrier to wide spread heating system conversion to the use of wood fuel.

The GNWT Department of Renewable Resources expressed no concerns about the increased use of wood fuel in the Rae Edzo area. No unique wildlife habitats are expected to be disturbed. The possible ecological effects due to wood smoke air pollution were felt to be negligible.

The timber near the Rae Edzo community and in the proposed woodlot (Appendix 5) is not of merchantable quality. GNWT planners or federal DIAND forestry officials do not foresee any alternate uses for the wood in the Rae Edzo area. The GNWT have no policy and have not, in the past, directed commercial sawmill operators or wood fuel harvestors to undertake reforestation programs on harvested areas.

Community residents and local business people in Rae Edzo are generally in favor of the increased use of wood fuel for heating in the community due to the job opportunities created. All people quickly recognize that money retained in the community results in a stimulated local economy. Community attitudes do not represent a barrier to conversion.

8.2 CONSTRAINTS

CONSTANT ATTENTION TO A WOOD FIRE

A unanimous concern expressed by commercial, institutional and municipal heat system operators, as well as residential dwelling occupants, is the apparent need to manually refuel the wood burner every few hours. Residential occupants want the freedom to leave their homes for a few days without the danger of freezing water lines. Commercial, institutional, and municipal operators are generally on hand for approximately 40 hours per week and efforts to manually feed a wood fire during the rest of the 168 hour week would result in increased operating costs.

To alleviate this concern, residence occupants or building operators strongly advise on the installation of a combined wood and oil fired heating system. In cases where the oil fired system is in place, the equipment is retained in a back-up role, and a wood burning appliance is added. An alternate approach is to install an automatic wood stoker unit to the burner. Wood fuel (usually chips) is mechanically removed from a storage bin or silo and fed into the burner at a rate controlled by heat demand. The storage bin is sized to hold enough wood fuel to allow for periods of no attendance. Due to the lack of experience in the community with stoking equipment, the wood/oil combination heating system is viewed with most confidence.

USERS ARE NOT THE PAYERS

A significant portion of residential housing in Rae Edzo is public housing rented to tenants, housing supplied to employees by the employer, or private housing where heating fuel costs are paid for by social assistance. For municipal and institutional buildings, the heating system operator is not personally linked in a financial sense to the consequence of energy conservation or energy misuse. In these instances, since those responsible for the consumption of heat energy are not accountable for the efficient use of heat energy, and are not directly financially affected by the

adoption of conservation practices or wood fuel heating, the impetus to adopt wood fired heating systems is weak to non-existant. In all of these instances, the motivation to conserve energy and cut costs is left with an employed administrator, likely with various other responsibilities, possibly living outside the community, and again not personally linked to the financial consequences of energy conservation.

Motivation to convert residences to wood fuel use can be achieved by the charging of rents net of energy costs and having the occupants pay for energy use separately, based upon their consumption. Good quality, properly installed wood burning appliances would be purchased and installed initially at the dwelling owner's expense. Employed administrators can best be motivated to take action to cut heating costs by directives from supervisors and/or elected officials. Publicity and education on the newer efficient, reliable technology and the financial benefits possible must be provided to these decision makers -- probably by workshops and publicity programs delivered by EMR - Canada.

Specific municipal and institutional installations projected to be economically viable by this assessment, should be reported to senior authorities responsible for these agencies. This contact, initiated by EMR or the Hamlet of Rae Edzo should be followed by personal contact, dialogue, and the commitment by the agencies to seriously and promptly examine the energy conservation opportunity, and implement a wood fuelled heating system.

The lack of a conversion program promoter, to press for action to install wood burning equipment, is viewed as a major impediment to the extent of wood conversions installed. The Hamlet may be the most appropriate promoter, although the manpower and financial resources to do the job are not available. EMR is the logical second choice, as part of their role to facilitate energy conservation.

Commercial business operators are not strongly motivated to adopt wood fuel for heating purposes. Local entrepreneurs have survived often because they face little or no competition for their goods. Accordingly,

local entrepreneurs merely pass on the costs of building heating and other business overheads to their customers through the level of markup on prices. The use of wood fuel is viewed as positive for community employment generation and hence their business income, but those interviewed did not want the apparent labour, expense or bother attendant with wood heating equipment. Education on the existence and reliability of automated wood stoker equipment, and the true low added workload associated with modern wood burning appliances may change this outlook. A readily available and dependable source of wood chip fuel also must be demonstrated before some operators can be expected to risk an investment in an automatic wood fuel heating system.

FUEL AVAILABILITY

A survey of the quantity of fuel wood economically harvestable from a recent fire killed region near Edzo was completed in 1983 by DIAND forestry technologists. Exerpts from the survey are presented in Appendix 5. The total quantity of economically harvested fuel wood to support the community has not been established. Broad area inventory data is not available for the region. Aerial photography apparently exists. However significant ground truthing work is necessary to quantify the aerial photograph interpretations. In general terms, the whole region from Rae Edzo to Fort Providence has a tree covering of small diameter pine, and other non-merchantable timber. Past experience suggests that GNWT authorities and DIAND forestry officials may support a wide spread wood conversion program on the condition that adequate fuel wood resources are identified in advance.

YELLOWKNIFE WOOD HARVESTORS

Most Yellowknife private or commercial wood fuel harvestors secure permits for wood gathering at the Mosquito Creek burn woodlot near Edzo. In the past (1982 - 83) confict has erupted between Rae Edzo and Yellowknife residents with Rae Edzo people claiming that cut and stacked logs have been stolen at their loading points in the woodlot by "outsiders". A

harvesting plan, proposed by DIAND as part of the fuel wood survey (Appendix 5) suggested the four woodlot areas be specifically assigned and marked with signage for use by one community or the other.

A reserve of wood fuel for harvesting by the Yellowknife community must be assured as part of any area plan for large scale wood gathering.

AIR QUALITY IMPACT DUE TO WOOD BURNING

The degradation in air quality due to particulate and gaseous emissions from wood burning has become a significant cause for concern in some North American communities. The communities of Medford Oregon, Juneau Alaska and Whitehourse Yukon have been closely monitored by government air quality agencies and active pollution reduction measures put in force to combat sometimes acute pollution levels. The burning of wood fuel creates carbon monoxide, carbon dioxide, water vapour, volatile hydro carbons, polycyclic organic matter POM, and particulate matter. The particulate matter is composed of inorganic ash, carbon char and various condensable organic compounts (ref. 18). The condensable organic compounds range from organic acids to phenols, aldehydes and more polycyclic organic matter POM. POM consists of over twenty separate compounds. Some of these compounds, collectively called polynuclear aromatic hydrocarbons (PAH), are known cancer causing agents. Two recent studies have identified over 100 different substances in wood stove emissions; fourteen are known carcinogens, and seven are highly carcinogenic (ref. 18). Consequently, the burning of wood fuel does present health hazards and attention should be paid to control air pollution levels to meet recognized air quality emission standards, and care taken to burn wood fuel in an efficient manner to minimize pollution production.

Significant air pollution levels created by wood burning generally result from a combination of a ground level thermal inversion in the atmosphere and a valley type topography to trap the air to prevent mechanical mixing and dispersion of the pullutants. A measure used to empirically predict pollution potential is the metcorological "ventilation coefficient" (ref. 18).

The Canadian arctic generally is considered to be the most air pollution prone region in Canada in the winter season. High pollution potential is said to exist for synoptic ventilation coefficients of less than 6000 m^2/s. Values of less than 1000 m^2/s frequently occur in the N.W.T.

The problems of other communities and the extent of potential health hazards must be tempered by the specific circumstances at Rae Edzo. The Whitehorse Riverside community and the Juneau Mecham Hall valley community both reside in mountainous topography. The communities are surrounded with steep cliffs creating a bowl to trap air movement. Temperature inversions occur at Whitehorse on 30 - 50% of winter days. The topography at Rae consists of rock outcrops in silty clay. The community is located on the lake shore of Marian Lake. No significant height of land changes or obstructions to air mass movement exist. Edzo is located away from the lakeshore on sandy soil covered by timber. No significant air flow pattern modifying topographical features are present. The communities probably have at least weak ground level inversions on 30 - 50% of winter days (AES Yellowknife)

The extent of air pollution in Whitehorse is due to other factors in addition to climate and topography. The Atmospheric Environment Service report that many domestic wood burners are using natural convection, older design wood stove units, often located in the basement. The units are frequently oversized and consequently are operated at a low firing rate in relation to their heating capacity. Since a slow burning fire generates much more creosote and pollutants than a robust full capacity fire, the smoldering fires contribute more to the pollution released. Rae Edzo has the benefit to choose effectively sized, modern, efficient wood burning appliances, and consequently can avoid this cause of pollution.

Methods used to combat excessive solid fuel burning pollution variously in Christchurch New Zealand, London England, Juneau Alaska, or various communities in Oregon and Colorado include the compulsory certification of wood appliance designs against pollution emission standards, legisla-

tion and fines for the operation of solid fuel burners during periods when community pollution loads exceed prescribed levels, and voluntary public participation programs to reduce burning or improve burning efficiencies during pollution events. None of these practices are apparently followed in Whitehorse. The complexities of establishing an emission certification program, test methods, emission standards are discussed in reference 19. No substantial plans apparently exist to set up an emission certification program in Canada.

Considering the effect of wood burning pollution and the experiences of certain other communities on one hand, and the specific circumstances at Rae Edzo on the other, the potential for serious pollution problems resulting from widespread conversion to wood burning in Rae Edzo is judged to be low. The community topography is level; the population is low; and the wood burning appliances are new; all factors mitigating against the build-up of excessive pollution in the community. A more scientifically based judgement on the pollution potential would require climatological modelling of the Rae Edzo community.

IMPACT OF COST EFFECTIVE ENERGY MEASURES

The economic payback period possible from conversion to wood fuel is reduced if, after a wood burning appliance is purchased, the amount of heat energy required is reduced due to the implementation of other building conservation measures such as increased insulation, air tightness, modifications to air handling systems, etc. No structures in the community were constructed with "R-2000 program" like highly efficient thermal designs. Accordingly, it can be argued that all buildings in the community could reduce their present fuel oil consumptions by implementation of various energy conservation measures.

The quantitative impact on community energy use due to the possible implementation of various energy conservation initiatives was not established. The economic viability of a particular wood conversion project can be maintained to a major extent if the wood burning equipment is purchased after

other conservation measures have been completed and the wood burning equipment is sized to be appropriate for the new reduced heat load.

FIRE SAFETY

Creosote build-up and improper chimney installation and appliance clearances are potential causes of fire due to wood burning equipment. The GNWT Safety Division Fire Safety section reported that surprisingly few wood appliance related fires have occured in recent years. In most cases, the fires reported were chimney fires caused by creosote build-up and negligence in cleaning. In one case, the chimney installation did not observe correct clearances and combustible building materials in the chimney encasement were ignited. The GNWT Fire Marshal office and the City of Yellowknife fire inspection personnel both felt that a proficient level of wood fire safety awareness exists in the area, due perhaps to bygone days when wood fuelled cookstoves and rudimentary forms of wood heating equipment were commonplace. Local experiences confirm that, if CMHC installation guidelines are followed (ref. 16), the wood burning installations are safe.

NAIVETE OF TECHNICAL AND BUREAUCRATIC PEOPLE

Decisions to proceed with conversions to wood fired heating systems in a majority of cases in Rae Edzo will be made by persons naive about wood burning technology and skeptical of supporting a perceived risky venture. Administrators in bureaucratic organizations must be educated and informed about the capabilities and reliability of current wood burning systems in order for these persons to have confidence in supporting the retrofit conversions of existing buildings.

The architectural and engineering community is also naive about current wood burning technology, and harbour myths about the reliability, operating requirements, and economic realities of modern, automated, efficient wood burning systems. A professional building design consultant is loath to recommend a heating concept that is not widely demonstrated, or that otherwise could cast dispersions on his credibility if complications

arise. The lack of awareness of successful technology demonstrations in other parts of Canada has contributed significantly to the high inertia displayed in the NWT to seriously consider wood fired heating systems in new public buildings.

A solution to this constraint must be quickly and vigorously pursued by EMR. We suggest that a major technical workshop and technology demonstration show be staged by EMR in Yellowknife in the fall of 1984. The show should have three distinct phases: A technical workshop aimed at architects, engineers, GNWT DPW project planners and technical staff; a workshop aimed at administrators including town and hamlet managers, works superintendents, government funding agency directors, etc. to present salient technical features, economic advantages, etc.; and thirdly, a display and exhibits show for all groups to see equipment first hand.

The technical workshop could be a one to two day session presented by various established national authorities in the related fields. Case studies and reports from key demonstration projects elsewhere in Canada can be presented. Prominent equipment vendors can be asked to discuss their product lines, capabilities and track record. The objective of the technical workshop is to give designers serving the NWT the opportunities to learn about current technology, the requirements for successful installations, and in-depth responses to their technical questions.

A one-half to one day "administrators" workshop would touch on the current technology and successes in less technical terms, and review the economics and discuss the financing options and barriers to implement wood burning installations. The product display exhibition would serve to introduce vendors and their products to planners and prospective purchasers in an effective manner.

The presence of this constraint probably is the primary reason why the Rae Nishi Khon Centre, and the new recreation complex, do not have wood burning heating systems today.

TO: Roger Jones
Superintendent,
Dept. of Social Services
Government of N.W.T.
FORT SMITH, N.W.T.

FROM: Violet Camsell, Chairperson
Community Service Steering Committee
Rae Dene Band Office
RAE, N.W.T.
X0E 0Y0

DATE: January 22, 1984

RE: Request for a wood heating system for the Senior Citizens Home in Rae.

Wood chip fired heating systems have been tested and proven as reliable and economic sources of heat for large buildings.

The additional advantage to these systems is that they create jobs in the communities where unemployment is rampant.

On behalf of the steering committee I request that the Senior Citizens home, which is currently being designed, have as its main system a wood or combination wood/oil heating system.

This recommendations came from the January 11, 19[illegible] Steering Committee meeting.

Yours truly,

Violet Camsell,

VC/mbs

cc: Minnie Letcher
Area Service Worker

Northwest Territories
SOCIAL SERVICES

166

4403 Rae

RECEIVED
FEB 24 1984
RAE BAND
Rae, N.T.
X0E 0Y0

February 21, 1984

Ms. Violet Camsell
Chairperson
Community Service Steering Committee
Rae Dene Band Office
Box 8
Rae, N.T.
X0E 0Y0

Wood Heating System/Senior Citizens Home

This is in response to your letter regarding the possibility of a wood chip heating system for the Senior Citizen Home proposed for Fort Rae.

I have discussed this matter with Mr. Willie Herzog, Construction Division, NWT Housing Corporation, who indicates that a wood chip heating system may not be feasible due to the current budget restraints on the project. Also a wood chip system requires a larger heating facility and wood storage area, which may be too large for the proposed site of the Home. Another possible drawback is that a wood chip system requires a full-time person to maintain it which had not been forecast in the O&M budget for the building.

However, the Consulting Engineer working on the project will do a cost benefit study on a wood chip heating system for the Home so that a more exact picture can be obtained of the pros and cons of a wood chip heating system over a conventional oil furnace.

When the cost benefit study is finished I will have the results made available to the Committee.

Roger Jones
Regional Superintendent

cc. Area Supervisor
Rae/Edzo, N.T.

Government of the Northwest Territories, Box 1320, Yellowknife, N.W.T. Canada X1A 2L9 (403) 873-7151

FINANCIAL CONSTRAINTS

Capital funds for institutional and municipal facilities are generally very scarce. Designs and approaches resulting in decreased capital costs in favor of increased operating costs (with net life cycle cost penalty) are often adopted in order to get a project going. Also in municipal facilities capital funds often come from the government, but operating costs are borne by the Hamlet. The benefits of present investments in wood fired heating facilities by the government are not therefore recovered by the government, but accrue to the Hamlet. This acts to reduce the attractiveness and increase funding complications for wood fired heating systems in new buildings.

In private residential dwellings many people simply cannot gather the funds or arrange the credit to finance their portion (after partial grant support) of the capital costs of a wood furnace or wood stove installation. The economic gains "on paper" due to the purchase of a new efficient wood appliance are often not actual savings since wood gathering is a spare time "no explicit cost" activity in any case.

WOOD LOT DEVELOPMENT

Some costs for the development of roads and access trails into the wood lots were factored into the production cost of wood fuel. If the harvesting is performed on a cottage industry basis or individuals harvest wood for their personal use, some external guiding hand (DIAND - forestry, Hamlet of Rae Edzo?) may need to plan, organize and manage the wood lot activities somewhat to put the access trails in place. The wood lot resources may not be judiciously exploited and the fuel could become difficult and costly to harvest unless some plan is followed.

The questions of Who controls the wood lot?, Who pays the costs of roads and access trails? remain unanswered.

9.0 SOURCES OF FUNDS TO SUPPORT CONVERSION

A variety of funding sources exist to provide assistance to implement energy conservation measures, adopt alternate fuel sources (off-oil) or demonstrate renewable energy technology. A summary and brief description of programs is given on the following pages. The list may not be exhaustive. Funding programs usually have a fixed termination date. The programs occasionally receive a name change, are combined with other programs, or change adminstrating agency. Accordingly, some information contained in this summary may become obsolete quickly. The Yellowknife Conservation and Renewable Energy Office of Energy, Mines and Resources Canada can provide assistance in identifying government funding sources appropriate to specific projects.

Funding programs also exist to assist wood harvesting contractors establish their businesses, and individuals receive training to do furnace installations, operate boilers, etc. Some of these programs are outlined below. Useful sources of assistance to find appropriate support programs are: The Yellowknife CEIC Office, for training support; DIAND - Economic Development, GNWT - Economic Development, Federal Department of Regional Industrial Expansion, Canada-NWT Economic Development Agreement Secretariat, all in Yellowknife, for business assistance funds.

PROGRAM TITLES

(The program numbering used below has been created by the consultant for this report.)

N.W.T. ENERGY FUNDS

NWT-1 Home Heating Assistance Program

NWT-2 Energy Conservation Public Awareness Program

NWT-3 Commercial Power Assistance Program

N.W.T. BUSINESS FUNDS

NWT-4 Small Business Loans and Guarantees Fund

NWT-5 Assistance to Industry

NWT-6 Small Business Development Assistance

NWT-7 Economic Development Agreement (E.D.A.)

N.W.T. TRAINING FUNDS

NWT-8 Apprenticeship Training

NWT-9 On-the-Job Training

FEDERAL ENERGY FUNDS

EMR-1 Canada Oil Substitution Program

EMR-2 Remote Community Demonstration Program

EMR-4 Super Energy Efficient Housing

EMR-5 Canadian Home Insulation Program (CHIP)

EMR-6 CANERTECH

EMR-7 ENERSAVE Advisory Service

EMR-8 Forest Industry Renewable Energy (FIRE)

EMR-9 Municipal Energy Management Program

EMR-10 Retrofit Program for Crown Owned Buildings

EMR-11 Internal Off-Oil Conversion Program

EPS-1 Development and Demonstration of Resource and Energy Conservation Technology

FEDERAL BUSINESS ASSISTANCE

DRIE-1 Special Agriculture Rural Development Agreement (Special ARDA)

FBDB-1 Federal Business Development Bank

DIAND-1 Indian Economic Development Fund

FEDERAL TRAINING FUNDS

CEIC-1 Canada Community Development Program (CCDP)

CEIC-2 Canada Manpower Industrial Training Program (CMITP)

CEIC-3 Other CEIC Programs

MISCELLANEOUS OTHER SOURCES

CMHC-1 Residential Rehabilitation Assistance Program

TAX-1 Class 34 Energy Conservation Equipment Fast Write-off of Depreciation

N.W.T. ENERGY FUNDS

NWT-1 Home Heating Assistance Program

A financial subsidy is available to NWT homeowners or renters outside Yellowknife, payable on the first 1500 gallons of fuel oil per year. The amount payable is the difference between the cost of fuel oil in your settlement and Yellowknife. Claimants must not be receiving a fuel or utility subsidy from their employer already.

Address:

The Department of Government Services
Government of the Northwest Territories
YELLOWKNIFE, N.W.T.
(403) 920-8662

NWT-2 Energy Conservation Public Awareness Program

Information and advice is available on a wide variety of energy-related subjects of interest to individuals, commercial operations, governments, or institutions. At the present time an accessible office is situated on the second floor of the Post Office in Yellowknife, where people can find a good variety of information on energy conservation and renewable energy. A small library of more detailed, specialized materials is also available. Advice will be given to many straight-forward conservation questions, guidance provided to appropriate resource materials, or referrals made to more expert advice when necessary.

As much as possible within budget, assistance to groups in the form of workshops, educational material and programs, awareness seminars, etc. will be offered on request in your community or field of interest. Requests for information by mail will also be welcome.

Address:

Energy Conservation Division
Department of Public Works
Government of the Northwest Territories
YELLOWKNIFE, N.W.T.
(403) 873-7203

NWT-3 Commercial Power Assistance Program

A financial subsidy available to commercial users of electricity outside Yellowknife, who do not have a gross annual revenue in excess of $2 million. The amount payable is the difference between commercial power rates in your settlement and Yellowknife, and applies to the first 1000 kWh/month. Claims retroactive to 1980 will be considered.

Address:

The Department of Finance
Revenue and Collections
Government of the Northwest Territories
YELLOWKNIFE, N.W.T.
(403) 873-7637

N.W.T. BUSINESS FUNDS

NWT-4 Small Business Loans and Guarantees Fund

The Government of the NWT administers this Fund to provide term loans and loan guarantees to business enterprises in the NWT where the required credit or other financial assistance is not available from other sources on reasonable terms and conditions. Loans and bank loan guarantees are limited to a maximum of $100,000 and a term of 15 years for the purposes of financing the purchase, installation, renovation, improvement, or expansion of equipment, inventory, or premises used or to be used in carrying on a small business enterprise.

Eligibility - New or existing business in the NWT whose gross revenues do not exceed $1 million per year.

Address:

Secretary Small Business Loans and Guarantees Fund
Department of Economic Development and Tourism
YELLOWKNIFE, N.W.T.

NWT-5 Assistance to Industry

This program is designed to provide contributions to private businesses, umbrella organizations and to government projects destined for private ownership. There is an element of flexibility to meet requirements for immediate interim financing, seed capital, or funds to complement development loans.

Eligibility - NWT residents and businesses planning to establish or expand operation in this area.

Address:

Commerce Division
Department of Economic Development and Tourism
Government of the N.W.T.
YELLOWKNIFE, N.W.T.
X1A 2L9
(403) 873-7229

NWT-6 Small Business Development Assistance

The Small Business Development Section provides technical support to entrepreneurs within the NWT. Emphasis is placed on the provision of business management, financial and accounting advice to individual businesses and industrial organizations. This section also provides expertise and advice in establishing a business in the NWT.

Eligibility - Any interested parties.

Address:

Small Business Development Section
Division of Commerce
Department of Economic Devleopment and Tourism
Government of the N.W.T.
YELLOWKNIFE, N.W.T.
(403) 873-7229

NWT-7 Economic Development Agreement (E.D.A.)

The Economic Development Agreement will provide $21 million for a cooperative and coordinated approach to the development of the human, natural and business resources of the Northwest Territores. The agreement will expire on 31 March, 1987.

The Economic Development Agreement provides for three sub-agreements which identify development programs and the funding available. These sub-agreements are:

Human Resource Development	$ 5.57 million
Natural Resource Development	4.68 million
Domestic Resource Development	10.75 million
	$21.00 million

The main aims of the Economic Development Agreement are:

- To sharpen the business skills of northerners so they can participate more fully in their community
- To support business growth and tourism development, community economic planning, and development of northern markets for northern goods
- To identify potential opportunities that exist in available renewable and non renewable resources
- To provide people in the Northwest Territories with the option of improving traditional economic activities and participating in wage employment opportunities

Address:

EDA Secretariat
P. O. Box 1030
YELLOWKNIFE, N.W.T.
X1A 2N7
(403) 920-8743

N.W.T. TRAINING FUNDS

NWT-8 Apprenticeship Training

Apprenticeship training is a combination of learning by doing (training on the job) and formal technical training. Apprenticeship programs are administered under the "Apprentices and Tradesmen Ordinance". The major activities the ordinance provides for are the Apprenticeship Board, Trade Advisory Committees and the designation of Trades.

Eligibility - Any individual employed in a designated trade at less than the journeyman level is eligible to be indentured as an apprentice.

Address:

Manpower Development Division
Department of Economic Development and Tourism
Government of the Northwest Territories
YELLOWKNIFE, N.W.T.
X1A 2L9
(403) 873-7553

NWT-9 On-the-Job Training

Essentially on-job-training is subsidized training on the job. This subsidy could include transportation assistance, and a percentage of reasonable wages. A "trainee" would work with a skilled person (usually in non-apprenticable trades) until the trainee can take the job. Coupled with this should be intensive life skills training and counselling. Individual contracts are signed for each training position between the employer and GNWT.

Eligibility - Any northern resident requiring this form of training.

Address:

Manpower Development Division
Department of Economic Development and Tourism
Government of the Northwest Territories
YELLOWKNIFE, N.W.T.
X1A 2L9
(403) 873-7553

FEDERAL ENERGY FUNDS

EMR-1 Canada Oil Substitution Program

Eligible Conservation Measures:

The following conservation measures are eligible for a payment under the Canada Oil Subsitution Program (COSP) in Newfoundland, Prince Edward Island, the Northwest Territories and the Yukon Territory, if your home or building is heated by oil or electricity.

Insulation:

The following materials are eligible under COSP and require a CMHC Evaluation Report Number:

- insulation materials for attic, roof, walls, basement walls, and floors over unheated spaces;
- vapour barriers;
- materials used for improved attic ventilation as specified by CGSB standard 51-GP42MP (these do not require a CMHC number).

The terms "CMHC Evaluation Report Number" and "CMHC Acceptance Number" are interchangeable and either is acceptable to ensure insulation eligibility under COSP. Liability for product performance is the sole responsibility of the manufacturer. The CMHC number does not imply Government of Canada recommendation or endorsement.

From 1981 November 1, only insulation contractors listed in the Canadian General Standards Board (CGSB) National Certification Listing Program for Residential Insulation Contractors are eligible to perform insulation work listed above and funded under COSP. From 1982 August 1, this requirement applies to general contractors, carpenters, home handymen, and so on.

Reducing Air Leakage:

The following materials are eligible under COSP but do not require a CMHC Evaluation Report Number:

- weather stripping and materials for reducing air leakage;
- protective shells around recessed light fixtures.

From 1982 August 1, contractors who install any of these materials are required to be listed by CGSB to be eligible for funding under COSP. These requirements apply to general contractors, carpenters, home handymen and so on.

Heating Systems Improvements:

The following equipment, material and labour costs associated with improving the efficiency of your existing oil-fired furnace are eligible under COSP:

- retention head kit for oil burner
- delayed action solenoid valve for oil burner
- replacement high efficiency oil burner
- liner for combustion chamber where an improved burner or retention head has been installed
- nozzle (where the nozzle has been downsized to increase furnace efficiency)
- tape and insulation for existing air distribution ducts
- pipe insulation for existing water circulating pipes
- thermostatically controlled valves (for zone control)
- automatic set-back thermostats
- temperature modulating controls for boilers
- positive chimney damper (must be ULC or CSA approved)
- water heater insulation

Ineligible Measures:

The following are examples of equipment, materials, and labour, associated with heating systems improvements, that are not eligible under COSP:

- normal cleaning and servicing
- cleaning or replacing the heat exchanger, flue pipe or chimney
- burner servicing not associated with retrofit or replacement
- fan motor replacement or servicing
- changing or replacing oil storage thanks, gauges, filters or lines
- changing hot water to hot air systems, and vice versa
- relocating a furnace or other related equipment
- the purchase or installation of a new or replacement oil furnace or any part thereof
- the purchase, installation or servicing of a heat pump, heat exchanger, humidifier, electrostatic air cleaner, air conditioner, or air conditioning equipment
- labour carried out by the applicant or the applicant's spouse
- piping, ducting, or installation of heating devices in previously unheated or new areas.

EMR-2 Remote Community Demonstration Program

To help reduce dependence on oil, the federal Department of Energy, Mines and Resources has established the Remote Community Demonstration Program. This Program is designed to help remote communities and agencies responsible for their energy supply to identify more appropriate energy alternatives and energy conservation opportunities. The Program offers limited financial assistance for carrying out studies to explore these alteratives and opportunites.

The Program will also promote awareness of appropriate alternatives and opportunities to as many communities as possible. To do this, it will contribute funds to a limited number of demonstration projects in selected remote communities across Canada. It will then transfer the knowledge gained from funded studies and projects to all communities and agencies where this knowledge is needed.

The Program aims to help communities achieve greater energy self-reliance, lower long-term energy costs and, in some cases, increased levels of electrical service for home, community and local industrial needs.

Eligible Communities:

To be considered under the Program, communities must be permanent (or have at least five years of planned life remaining) and have no less than ten occupied principal residences.

Such communities are eligible if

- they are in the Yukon Territory or Northwest Territories,
- they are in a province and are off the electrical grid and are not served by natural gas pipeline.

Communities for which there is a firm commitment for connection to grid or natural gas distribution systems are not eligible.

Eligible Applicants:

Eligible applicants include:

- eligible communities as represented by recognized local organizations (preferably local governments)
- groups of eligible communities with common supply possibilities as represented by recognized associations
- companies (e.g. forestry, mining) that maintain eligible communities as part of their operations
- provincial or territorial utilities
- federal departments and Crown corporations
- other levels of government and Crown corporations (e.g. provincial, territorial)
- other agencies responsible for, or directly interested in, energy supply and conservation for remote communities.

Eligible Technologies and Measures:

The focus of the Program is on mature and highly promising technologies for alternative energy supply and measures for energy conservation. These should have potential for near-term implementation in remote communities. The Program will endeavour to support as wide a range of technologies and measures as possible, including:

- renewable energy supply using hydro, biomass, wind and other fuel sources
- non-renewable energy supply using local natural gas, peat and coal sources
- cogeneration and waste heat recovery which permit more efficient use of oil-fuelled systems
- district heating
- heat pumps
- various energy conservation measures
- grid extensions (in the study phase only)

Studies eligible included:

- energy use analyses
- energy option identification and analyses
- energy pre-feasibility and feasibility studies
- energy resource base studies

Schedule:

Phase 1

Applications for assistance to carry out studies will be received **September 30,** 1984. All funded studies must be completed by **March 31, 1985.**

Phase 2

Phase 2 consists of demonstrations and information transfer. Details of and application procedures for Phase 2 are being announced separately. All funded demonstration projects must be completed by March 31, 1989.

Program funds are limited and will be awarded on a competitive basis according to predetermined selection criteria and Program priorities. Details of these criteria are also available from Conservation and Renewable Energy Offices.

Further Information:

Further information about the Program is available from the Conservation and Renewable Energy Office:

Conservation and Renewable Energy Office
Energy, Mines and Resources Canada
Northwest Territories
Precambrian Building
10th Floor, Precambrian Building
4922 - 52 Street
YELLOWKNIFE, N.W.T.

or

P. O. Box 68
YELLOWKNIFE, N.W.T.
X1A 2N1
(403) 920-8475
Zenith 2828 (toll-free)

EMR-4 Super Energy Efficient Housing

Buildings and residential: Super energy-efficient housing demonstration: This program will provide a total of $6 million to construct approximately 1,000 super energy-efficient housing units across the country over a three-year period from 1981-82 to 1983-84. Funding available under the program (average $6,000 per house) must be used to assist in the design and evaluation of houses constructed in the demonstration projects, to train builders and trades people in the appropriate techniques involved in construction. Details of the program will be developed in cooperation with provincial governments and representatives of the home building industry.

EMR-5 Canadian Home Insulation Program (CHIP)

The CHIP grants of up to a maximum of $500 are available to householders with houses built before 1977 in most provinces. In the Yukon and the Northwest Territories houses built before 01 January 1977 are eligible. The grant covers the cost of insulating materials up to $350 and $150 for one-third the cost of labour.

EMR-6 CANERTECH

This new Canadian alternate energy Corporation, established to further enhance the supply of renewable energy, will focus on supporting commercial production of renewable energy and conservation technology. As a provider of venture capital, CANERTECH will support enterprises that produce leading technological hardware for sale at home and abroad. It may also enter into other shared ventures, or undertake commercial production independently. Where necessary in order to further these activities, the Corporation will carry out research, development and demonstrations. The Corporation has been established initially as a wholly-owned subsidiary of Petro-Canada.

Inquiries: Winnipeg (204) 949-1160

EMR-7 ENERSAVE Advisory Service

Information on energy conservation and renewable energy: The Enersave Advisory Service is a national information centre responsible for promoting home energy conservation and substitution of oil with other forms of home heating. Located in Ottawa, its principal services include offering a free computerized analysis of a house-holder's insulation requirements and operating the HEATLINE. Information is also available on renewable energy forms such as solar, biomass, wind, geothermal, tidal and ocean energy, small-scale hydroelectric power, and new technologies such as heat pumps. The HEATLINE is a toll-free telephone advisory service that responds to general and technical questions on home energy conservation and the Canada Oil Substitution Program.

Inquiries:

Ener$ave Advisory Service
P. O. Box 4510, Station E
OTTAWA, Ontario
K1S 5K3
(613) 995-1801 (call collect)

EMR-8 Forest Industry Renewable Energy (FIRE)

FIRE is a capital cost-sharing program to encourage the substitution of such biomass fuels as wood, municipal waste, peat and agricultural products for purchased energy. Financial incentives are provided to convert existing facilities, or to install new facilities, utilizing biomass fuels, and thus reducing the dependence on non-renewable resources. Contributions of up to 20% of capital costs will be provided for approved projects.
Funding will be provided until 31 March, 1986. Industries, institutions and all other organizations willing to provide energy production facilities in the form of heat and electricity using biomass residues in place of energy produced from non-renewable sources may apply.

EMR-9 Municipal Energy Management Program

To assist Canadian communities in hiring full-time energy managers, funding is available to pay the first year salaries of about 900 municipal energy managers contingent upon agreement by the municipalities to continue funding for at least one additional year. The program is expected to increase energy savings in three main areas:

- municipal energy management of municipal buildings, vehicle fleets, street lighting, water and sewage treatment
- review of services, by-laws and municipal planning to analyse relevant regulations with the view to promote energy savings
- community involvement by providing guidance to community organizations to promote conservation.

EMR-10 Retrofit Program for Crown Owned Buildings

The purpose of this program is to implement capital intensive, cost-effective energy conservation measures to reduce energy consumption in federal government buildings. This is to be achieved through three main initiatives:

- implementation of restrictive measures for the control of environmental systems
- implementation of improved routine preventive maintenance of installed building systems
- the conducting of energy audits and analyses leading to retrofit of building enclosures and installed electrical mechanical systems.

EMR-11 Internal Off-Oil Conversion Program

The goal of this program is to carry out the conversion of Crown-owned facilities from the use of fuel oil to an alternate source of fuel.

EPS-1 Development and Demonstration of Resource and Energy Conservation Technology (DRECT)

DRECT assists the private sector, municipalities and provinces to develop and demonstrate equipment, systems or products designed to reduce waste; recover or recycle wastes; and save energy, especially the energy derived from non-renewable resources. Under the Program DRECT will pay up to 50% of the total estimated costs of an approved project.

Eligibility:

Industries or organizations with appropriate proposals.

Address:

DRECT Secretariat
Environment Protections Service
Environment Canada
OTTAWA, Ontario
K1A 1C8
(819) 997-2057

FEDERAL BUSINESS ASSISTANCE

DRIE-1 Special Agriculture Rural Development Agreement (Special ARDA)

This joint federal-territorial program can provide financial contributions and other assistance to projects which create new jobs, increase income and improve living conditions of residents of the Northwest Territories, particularly those of Indian or Inuit ancestry. Types of eligible projects include commercial businesses resource harvesting, training and special measures needed to help people take advantage of job opportunities. For commercial projects contributions of up to 50% of the costs may be provided.

Eligibility:

For commercial projects a majority of employees must be of Indian or Inuit ancestry. Viability of the proposal is a strong consideration. Priority is given to proposals incorporating Native entrepreneurship.

Address:

Department of Regional Economic Expansion
10th Floor, Precambrian Building
P. O. Bag 6100
YELLOWKNIFE, N.W.T.
X1A 1C0
(403) 873-6225

FBDB-1 Federal Business Development Bank

Extends Financial Assistance to new or existing business of almost every type in Canada which do not have other sources of financing available to them on reasonable terms and conditions. Management Services provided to help improve management skills; seminars conducted in smaller centres to meet the needs of the owners and managers of small businesses; sponsors and supports conferences to promote good management practices; develops management training courses for distribution to provincial education authorities. Information Services publishes and distributes booklets on a wide range of topics pertaining to small business; distributes bulletins on business at branch offices with a variety of publications on small business management.

Eligibility:

Financing available to most Canadian companies (with emphasis on the needs of the small business) by means of loans, loan guarantees, equity financing or leasing, or by any combination of these methods. Ranges in size from a few thousand dollars upward. Business may obtain FBDB assistance on more than one occasion if they meet its requirement.

Address:

Federal Business Development Bank
5202 Franklin Avenue
YELLOWKNIFE, N.W.T.
(403) 873-3565

DIAND-1 Indian Economic Development Fund

The program provides advice, assistance and financial support in the field of economic development to Indian people, individually or groups. Financial support in the form of an accountable contribution may be made available for socio-economic research and planning for business development, in such items as capital costs, equity and technical costs. Financing in the form of direct and loan guarantees also form part of the program, on a last resort basis.

Eligibility:

The program's primary mandate is to deal with status (Treaty) Indians either individually or as a group. The program can participate with non-status Indians where community based issues are involved, and where it can be established that significant meaningful benefits will accrue to status Indians.

Address:

Economic Development Section
Indian and Inuit Affairs Program
P. O. Box 2760
YELLOWKNIFE, N.W.T.
(403) 920-8281

FEDERAL TRAINING FUNDS

CEIC-1 Canada Community Development Program (CCDP)

The CCDP is designed to allow communities to undertake projects of lasting value which also have the benefit of supplying work to persons who would not otherwise be employed.

Address:

Canada Employment and Immigration
Bag Service 1170,
YELLOWKNIFE, N.W.T.
(403) 920-8411

or

Canada Employment and Immigration Commission
Room 610, Manulife Building
10055 - 106 Street
EDMONTON, Alberta
T5J 2Y2
(403) 425-4582

CEIC-2 Canada Manpower Industrial Training Program (CMITP)

CMITP is a shared-cost incentive program whereby employers are reimbursed by the Commission for a portion of their incurred training costs. The overall objective of CMITP is to meet the skills needs of employers and to improve the employability and earning capacity of workers through the initiation, expansion, and improvement of employer-provided training.

Eligibility:

Employers qualifying for CMITP are: any incorporated company, a partnership or sole proprietorship, an incorporated association of employers, a crown corporation or other government department; a cooperative, credit union, incorporated Indian Band, or similar legally constituted organization, any legally constituted association, union or community organization.

Address:

Canada Employment Centre
Bag Service 1170
YELLOWKNIFE, N.W.T., X1A 2L9
(403) 920-8400

CEIC-3 Other CEIC Programs

The CEIC provides a wide range of services designed to assist businesses in the recruiting and upgrading of staff and many of these are useful to small firms. The following is a list of various programs administers by CEIC and its Canada Manpower Branch:

- Canada Manpower Industrial Training Program (CMITP)
- Small Business Intern Program (SBIP)
- Local Employment Assistance Program (LEAP)
- Canada Community Development Program (CCDP)
- Canada Community Services Program (CCSP)
- New Technology Program (NTP)
- Local Economic Development and Assistance Program (LEDAP)

Eligibility:

Any employer or employee may make use of the services available or apply for assistance through various programs.

Address:

Employment and Immigration Canada
Bag Service 1170
YELLOWKNIFE, N.W.T.
X1A 2N8
(403) 920-8411

MISCELLANEOUS OTHER SOURCES

CMHC-1 Residential Rehabilitation Assistance Program

This CMHC program provides financial incentives for repair, rehabilitation or conversion of residential dwellings as well as promoting subsequent maintenance. The program is restricted to designated areas and properties must meet certain criteria. Borrowers meeting certain income tests may be forgiven portions of loans which are at preferential interest rates.

TAX-1 Class 34 Energy Conservation Equipment Fast Write-off of Depreciation

This program is designed for industrial and commercial users with the goal of increasing energy efficiency, reducing oil use, and increasing the use of renewable energy resources. The fast write-off of 50% on a straight line basis is applicable to machinery and equipment covered in Capital Cost Allowance Class 34 of the Income Tax Act.

10.0 RAE EDZO WOOD CONVERSION PLAN

10.1 GENERAL

The objective of the plan outlined in this section is to identify the steps and the implementation methods to be followed in order to convert building heating systems in the Rae Edzo community to the primary use of wood fuel, in cases where the economic viability is apparent.

A review of present buildings identified a number that were candidates for conversion, based on a variety of factors, excluding economic return on investment. The suitability of the candidates for conversion were rated in the Table 2.1/1 and 2.1/2 and are retabulated below, now leaving out buildings or building groups where economic viability was judged to be poor. Poor viability was arbitrarily assigned to candidates with a simple economic payback period of longer than 15 years, computed from baseline analyses.

	Type of Wood Appliance
A. SUITABLE FOR IMMEDIATE CONVERSION	
1. Residential Dwellings	wood furnaces
2. Hudson's Bay Co. Store	wood furnace c/w stoker
3. Roman Catholic Church Mission	wood stove
B. GOOD PROSPECTS FOR CONVERSION	
1. Residential Buildings	wood stoves wood furnaces
2. new Hamlet Equipment Garage	wood boiler
3. Jimmy Bruneau School	wood boiler
4. Cottage Hospital	wood boiler
5. Nishi Khon Area Central Heating System	wood boiler

Residential dwellings were included in both groupings as they were examined on a typical basis and no particular house was delineated in the survey.

The Management Committee for this study, consisting of representatives from EMR Canada, and the Hamlet, have reviewed the economic analysis presented herein. The decision was reached to pursue the conversion of all residential dwellings to the use of wood fuel as a primary heat source. The objectives for residential housing conversions are:

a) for all public housing units presently fitted with oil furnaces, convert the homes to wood heating using one of the three furnace types indicated in Section 5.3.

b) for all private housing, upgrade existing wood burning appliances to state of the art equipment.

10.2 CONVERSION PLAN STEPS

The specific steps to create the widespread use of wood fuel for heating purposes are outlined below covering the next couple of years of activity. The person or group responsible to complete the step is suggested.

Step 1 ADOPT A WOOD CONVERSION POLICY - DESIGNATE A PROGRAM MANAGER

The community of Rae Edzo Hamlet Council will become familiar with the results of this study and the quantitative projections of benefits possible due to wide spread wood conversion through a presentation of the study findings by the study consultant. The first step to initiate the accelerated conversion process is for the Hamlet to officially adopt a policy to promote and encourage the residential, commercial, municipal and institutional use of wood as a primary heating fuel for the Rae Edzo community. Adoption of the policy implies the Hamlet will <u>actively</u> pursue conversion initiatives.

The council must direct the Hamlet administration to assign to one person the responsibility to execute this wood conversion plan. If financial resources are not available for this Wood Conversion Program Manager, the EMR-Canada fund EMR-9 (Chapter 9) may provide the required support. The Wood Conversion Manager is responsible for initiating wood heating system conversion on the designated Hamlet buildings, and for promoting and pressuring the owners of other designated candidate buildings to switch to wood fuel.

The designation of a Wood Conversion Manager is viewed as the <u>most critical</u> action in this plan. Responsibility for the implementation of this plan must be clearly assigned, and the resources must be supplied in order for the plan to be successfully executed.

Step 2 CONTACT BUILDING MANAGERS & NWT HOUSING CORPORATION

The Wood Conversion Program Manager must contact by letter and arrange meetings with senior managers or political representatives responsible for the buildings designated for conversion. The persons include: President, NWT Housing Corporation, Vic Irving; Minister of Education, Dennis Patterson; Minister of Public Works, Gordon Wray; NWT Regional Director, Health and Welfare Canada; MacKenzie River District Manager, The Bay (Edmonton); etc.

The purpose of the contact is to inform the parties of the economic viability of the conversion to wood heating in their buildings, as estimated here, and to request they initiate a project to convert their facilities to wood fuel. EMR representatives should attend the meetings to describe the various forms of financial assistance that can be offered to assist with the conversion. The contact is likely to result in each building operator initiating their own assessment of the situation, and an ongoing series of negotiations and discussions prior to the owner committing to proceed. The job of the Program Manager will be to ensure that building owners' planning moves along at a reasonable pace, and that apparent road blocks to a favourable decision to proceed are always cleared.

Step 3 CONTACT DIAND FORESTRY

The Program Manager should inform regional forestry officials of the Rae Edzo Wood Conversion initiatives and request that their inventory assessment, woodlot harvesting plans, etc. keep pace with the Program.

Step 4 INITIATE HAMLET BUILDING CONVERSIONS

The Program Manager shall instigate a selection procurement and installation contract to place a wood boiler unit in the new Hamlet Equipment Garage. Prior to the selection effort, the actual fuel

oil consumption of the building should be rechecked to authenticate the economic analysis, and an energy conservation audit (with the assistance of EMR) should be made of the building to identify other cost effective measures that can be performed to reduce energy consumption. The community availability of chipped wood fuel must be established also.

Step 5 CONDUCT PUBLIC AWARENESS PROGRAM

The Program Manager shall request EMR Canada to take a leading role to deliver a community public workshop on the safety, efficiency and economic viability of domestic and commercial wood fired heating systems. The Program Manager and EMR will jointly plan the presentation, which must have a strong visual and oral emphasis (as opposed to reams of pamphlets and papers) in order to most effectively communicate with the community residents: The presentations, made by EMR, should address the correct and safe installation of equipment, product operating and maintenance practises, factors that influence heating efficiency and heating cost (wood moisture content, dwelling energy conservation measures, etc.) equipment preferred features, installation costs and grants available. Regional wood appliance stores could be asked to present displays of their products.

Step 6 PROVIDE SPECIFIC PRIVATE HOME INSTALLATIONS ASSISTANCE

The Program Manager should assist individual home owners to decide precisely what work must be done to install a new replacement wood burning appliance in the home, the type of appliance that is most suitable; the total expected cost of the installation; and assist the purchaser to secure a COSP grant, lineup equipment installers, etc.

Step 7 CONDUCT A TECHNICAL WORKSHOP ON WOOD BURNING TECHNOLOGY

Energy Mines and Resources Canada must assume the responsibility to organize and conduct a major workshop in Yellowknife on wood

burning systems and wood burning technology. Suggested details for the workshop are discussed in Section 8.2 under "Naivete . . .".

Step 8 MONITOR THE SUCCESS OF THE CONVERSION PROGRAM

The Program Manager must take actions appropriate to ensure an adequate supply of wood fuel is available to the community (e.g.: encourage entrepreneurs, deal with forestry, etc.); ash disposal is being smoothly carried out; air pollution is not becoming significant; and otherwise work to facilitate the successful conversion to and use of wood fuel in the community.

10.3 CONVERSION SCHEDULE

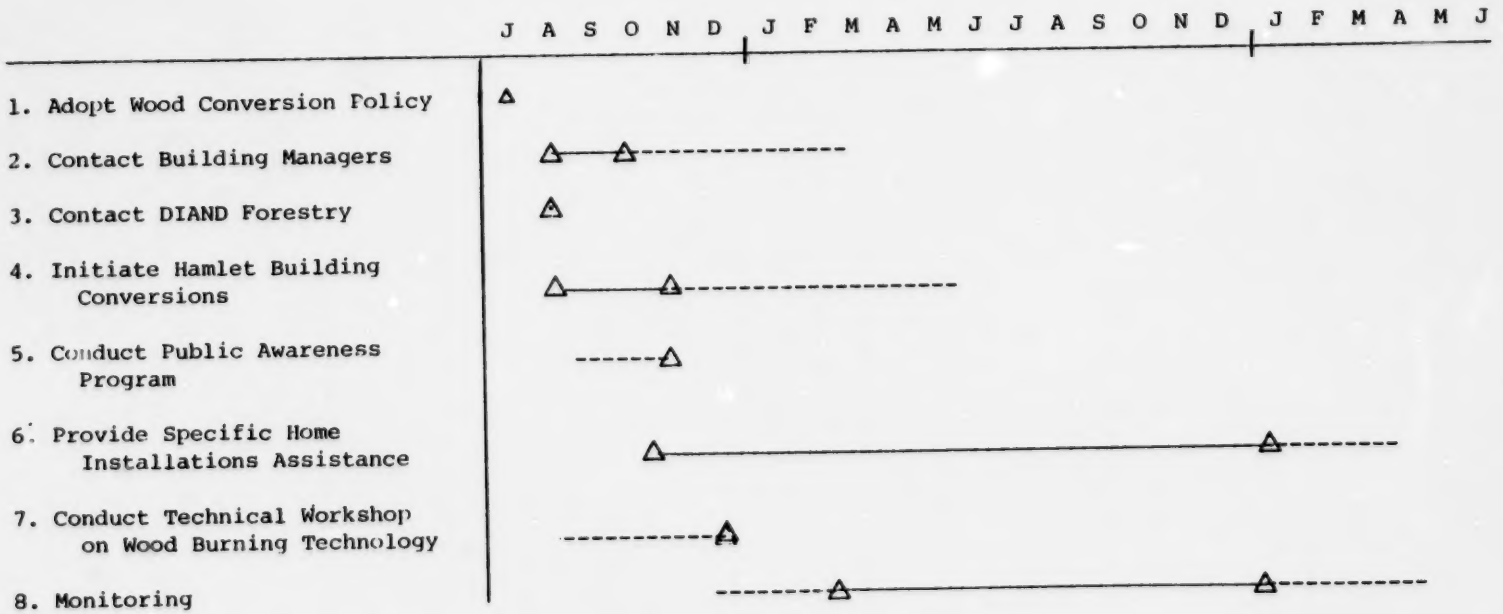
A time schedule, reasonable to guide the community wood conversion program is outlined in figure 10.3/1.

The schedule assumes that a Program Manager is put in place for August 1st, 1984, the public presentation/workshop in Rae is slated for late October in consideration for the time required to set it up. This presentation should be moved to mid-September if possible.

The most important first task of the Program Manager is to initiate contact with the various identified building owners to start their planning to install wood heating systems.

Figure 10.3/1

RAE EDZO WOOD CONVERSION PLAN SCHEDULE


J A S O N D J F M A M J J A S O N D J F M A M J
1. Adopt Wood Conversion Policy
2. Contact Building Managers
3. Contact DIAND Forestry
4. Initiate Hamlet Building Conversions
5. Conduct Public Awareness Program
6. Provide Specific Home Installations Assistance
7. Conduct Technical Workshop on Wood Burning Technology
8. Monitoring

10.4 ECONOMIC IMPACT OF THE CONVERSION PLAN

The economic impact on Rae Edzo of converting the homes and buildings listed in Section 10.1 over to the use of wood fuel as a primary heat source is profiled in this section.

Various measures of economic impact are presented in Figure 10.4/1. The background conditions that may prevail if no active conversion program is pursued have not been subtracted from the figures to arrive at a net impact position. The background conditions are addressed in following notes. The effects due to the possible inclusion of wood heating systems in the new recreation centre or a proposed school or proposed Old Folks Home were not added into this calculation.

a) A forecast of the community fuel wood requirements as a result of the conversion program is presented in Figure 10.4/1. The amount of fuel wood harvested for the community in the absence of an active wood conversion program is summarized in Table 3.3/1. A large number of assumptions about future events are incorporated into the calculations of the figures presented. While all of these assumptions are felt to be reasonable, the figures can only be judged as tentative. The major assumptions underlying the projection of fuel requirements are:

   i) private homes: The total fuel wood demand was judged to remain relatively constant for private homes in the absence of an active wood conversion program. This projection was based upon arguments cited in Section 3.3(c). The effect of an active wood conversion program may actually cause a reduction in private wood fuel use. The program will accelerate the substitution of poor efficiency equipment by modern high efficiency wood burning equipment. The number of private wood fuel users will increase at a modest rate in keeping with population growth and home ownership trends. However, the per dwelling wood fuel consumption is likely to drop substantially from the 14 - 15 cords/home figure. For this projection, it is assumed as reasonable, without analytical substantiation, that private housing annual fuel consumption will drop to 9 cords per home an average by 1988, to 5.67 cords per home in 1993 and remain at 5.67 cords per home through 2003. These rates are implied by the background assumption that, for program capital projections, all new private homes will be fitted with forced air wood furnaces, and that 50% of existing homes will have new wood furnaces by 1988, and 100% will have new wood furnaces by 1993.

Figure 10.4/1

ECONOMIC CONSEQUENCES OF

RAE EDZO WOOD CONVERSION PROGRAM

	1983	1988	1993	1998	2003
a) Fuel Wood Requirements	cords/year	cords/year	cords/year	cords/year	cords/year
i) Private Homes	1100	900	650	710	780
ii) Public Housing	150	1000	1060	1110	1160
iii) Commercial, Municipal, Institutional					
o Hudson's Bay Store		37	37	37	37
o Roman Catholic Church Mission		18	18	18	18
o Hamlet Garage		45	45	45	45
o J. Bruneau School		355	355	355	355
o Cottage Hospital		70	70	70	70
o Nishi Khon Area Central Heating System		104	104	104	104
TOTAL	1250	2529	2339	2449	2569
No. of cords of chipped fuel in above total	0	629	629	629	629
b) Equivalent Amount of Fuel Oil Replaced/yr. (616.6 L. = 1 cord air dried jack pine)	770,750 Litres	1,559,381 Litres	1,442,227 Litres	1,510,053 Litres	1,584,045 Litres
c) Summation of Installation Capital Costs for the 5 Year Period - commercial, et al	-	$ 489,000	-	-	-
- private residential	-	336,600	$ 336,600	$ 142,800	$ 153,000
- public residential	-	867,000	86,700	45,900	45,900
d) Amount of Funds Injected into the Rae Edzo & Yellowknife Community (over 5 yr. period)					
- installation related	-	595,000	160,000	70,000	70,000
- operations related	-	1,060,000	985,000	1,030,000	1,075,000
e) Local Jobs (Total man hours per 5 year period)					
- installation related	-	16,700 hours	5,200 hours	2,300 hours	2,500 hours
- operations related	-	45,600 hours	42,400 hours	44,200 hours	46,300 hours

ii) public housing: Presently 150 cords of wood fuel are consumed in public housing for cooking and heating. The existing dwellings using this fuel quantity are expected to be replaced in 1-3 years. The public housing is projected (starting in 1988) to contain a wood burning furnace in 100% of the homes. Wood stoves were assumed to consume 4.87 cords (air dried jack pine) per year; wood furnaces - 5.67 cords, consistent with the viability calculations in Chapter 6.0.

iii) commercial, municipal, and institutional: The amount of wood fuel required for each building is the amount computed as part of the economic viability analysis for the building, presented in Section 6.0. The quantities refer to air dried jack pine. Wet fuel or fuel of different species with a lower heating value would cause the fuel quantity figures to increase.

b) The total volume of fuel oil substituted by the projected wood fuel consumption was simply computed on the relation (developed in Section 6.1) 616.6 litres = 1 cord. This is a critical assumption to the whole table and implies that airdried fuel is burned, and further implies that fuel oil burners and modern wood burning appliances operate at the same efficiency, say 60%

c) The capital costs to purchase and install equipment over each 5 year period reflect the costs per typical installation assembled in Section 5. The purchase price figures are thus in "1984 dollars". The assumptions made concerning the number and type of heating appliance installed are identical to those made to forecast wood fuel requirements in a).

d) The funds injected into the regional economy over each 5 year period are assumed to include equipment installation costs, the total price paid for wood fuel consumed, and the salary costs of any new boiler operations staff. Most of the operations related funds will accrue to Rae Edzo residents; installation funds to Yellowknife contractors. The markup on the sale of wood furnaces or stoves by a local supplier was not included, since the source of purchase may be factory direct or from a southern distributer.

e) The local jobs available due to the widespread adoption of wood fuel are developed from the cost estimates of Sections 5 and 6, assuming all wood fuel used in the community is purchased from the contractor. The amount of jobs that exist in wood harvesting and oil fuel related services if the program does not go ahead are not estimated. The local fuel oil distributor would likely not lose his job - but he would have considerably less to do.

The fuel wood requirements for the community are shown to double to 2500 cords/year (air dried) due to the planned wood conversion program. In fact, the quantity of fuel wood could exceed 4000 cords/year if the moisture content of the fuel is not controlled and if wood burning appliances are not maintained. As noted elsewhere, improper wood stoking practices can lead to inefficient burning in the short run, creosote build-up, and poor operating efficiency in the long term.

10.5 SUITABILITY AS A TECHNOLOGY DEMONSTRATION PROGRAM

The suitability of the Rae Edzo Wood Conversion Program as a demonstration of viability of off-oil technology for others to adopt is an important consideration to capital funding support and grant agencies.

The program is judged to be a very effective technology demonstration program from the investigation work conducted. Just considering the western N.W.T. communities along the MacKenzie Valley with access to natural wood lots for fuel wood, they appear to represent a significant spin-off potential to adopt the successes in Rae Edzo. The current heating fuel oil use in these communities is tabulated in Table 10.5/1, taken from reference 6. By comparison, these communities consume more than 40 times the fuel oil as Rae Edzo. With similar fuel costs in these communities, the need for local employment, and the close communications that exist among the communities through regional government, newspapers, radio, etc., the prospects for many-fold replication of the Rae Edzo experience appears to be very good.

The list of communities notably does not include Yellowknife, with an annual fuel oil consumption of 6 million imp. gallons alone. Yellowknife was excluded since the Yellowknife wood supply is at Rae Edzo, for practical purposes, and a conversion program aimed at Yellowknife must address this additional problem.

The prospects for replication due to the Rae Edzo experience are also enhanced by the relative scarcity of wood burning furnaces and boilers now operational in the western NWT. Regional wood stove vendors indicate that while wood stove use in these communities is increasing, probably less than one half dozen residential or commercial wood furnaces have been sold and none with automatic stokers exist. Also only one commercial wood boiler operation exists - a 1982 installation at the water treatment plant in Fort Smith. The territorial and federal departments of Public Works have no experience with modern wood boilers technology upon which to confidently recommend the installation of wood boilers in new projects. The Rae Edzo Conversion Program will be particularly valuable to lead the way for widespread municipal and institutional conversions to wood fuel.

Table 10.5/1 FUEL OIL CONSUMPTION IN SELECTED N.W.T. COMMUNITIES*

	POPULATION	HEATING OIL (imp. gallons) TOTAL	Residential	Gov't Canada	Gov't N.W.T.	Local Municipal	Private Commercial	Unidentified
Enterprise	40	20,204	-	-	-	-	-	-
Fort Liard	394	40,835	2,324	13,828	3,984	6,238	6,012	8,449
Fort Providence	571	446,634	100,722	24,576	181,277	-	140,059	-
Fort Simpson	1,001	838,829	37,582	587,625	20,146	38,318	1,256	153,902
Fort Smith	2,234	1,094,079	113,501	74,819	219,160	119,055	333,876	233,668
Fort Resolution	523	215,018	76,164	25,814	41,637	-	71,006	397
Hay River	3,345	1,959,467	269,981	242,594	234,040	150,217	887,771	174,864
Lac La Martre	231	19,698	4,888	1,746	3,162	6,568	2,884	-
Nahanni Butte	92	9,136	-	-	-	-	-	-
Pine Point	1,719	125,008	3,504	-	28,326	64,655	28,523	-
Snowdrift	264	54,574	14,331	8,858	15,088	-	12,383	3,914
Trout Lake	61	1,060	-	-	-	-	-	-
TOTAL		4,824,542						
Rae Edzo	1,367	118,899	40,432	7,973	51,467	7,415	11,612	-

* Reference 6, 1978 - 1980 figures

NOTE: Units are imperial gallons: imp. gallons = 4.5459 Litres

11.0 CONCLUSIONS

The significant conclusions reached as a result of this assessment are summarized below.

1. GENERAL

a) The Rae Edzo community is strongly in support of the widespread adoption of wood fuel as a primary heating fuel.

b) The community prefers a wood lot harvesting approach which permits fuel gathering by private residents, small scale and large scale commercial operators.

c) The success of a community wood conversion program requires the Hamlet to actively pursue and assist building owners to make the investments in wood heating equipment. Responsibility for promoting wood conversion should be specifically assigned to a Hamlet employee.

2. COMMUNITY HEATING SYSTEMS

a) There is presently no wood burning appliances in community municipal, institutional or commerical buildings. Some wood fuel is used in residential public housing for cooking or heating purposes. Residential private housing uses wood fuel as the primary heating source.

b) Many wood burning appliances in private residential dwellings are inefficient, and in need of replacement.

3. COMMUNITY HEATING FUEL CONSUMPTION

a) Fuel consumption information is often not carefully recorded. Records generally consist of fuel purchase invoices, if saved, and sometimes lump all deliveries to various locations operated by one customer (Hamlet) into one invoice. Rae Housing Association and J. Bruneau School records are well kept.

b) The actual fuel wood consumption in the community is not well established.

c) In the absence of incentives and emphasis to use wood fuel, the quantity of wood fuel used is forecast to decline in the future.

4. WOOD BURNING APPLIANCES

a) A wide range of CSA approved, modern wood stoves, wood furnaces and wood boiler equipment exists, suitable for the applications found in the community.

5. CAPITAL COSTS OF CONVERSION

a) The capital costs to install a wood stove in a typical existing space range from $1500 - $2300, allowing for the installation of a 2100° F rated chimney.

b) Wood furnace installations cost approximately $5100 for a typical existing space. The costs are very similar for the installation of a new stand alone wood furnace, an add-on wood furnace to an existing oil furnace, or a wood-oil combination furnace.

c) Wood boiler installation costs vary widely depending on boiler size and installation work necessary.

d) The primary capital cost in central wood boiler plant projects is often the distribution line costs.

e) Distribution line costs are not readily estimated without detailed and site specific analysis.

6. ECONOMIC VIABILITY

a) The economic viability of projects are very sensitive to the costs of staff to operate or supervise the heating equipment.

b) Centralized or district heating plants supplying residential dwellings are not economical in Rae Edzo.

c) Wood fired heating boiler plants are economically viable for the Jimmy Bruneau School, the Cottage Hospital, and the new Hamlet Equipment Garage. Wood furnaces and wood stoves are economically viable for most residential dwellings.

7. COMMUNITY ISSUES

a) The skills required for fuel harvesting and the ongoing operation of wood burning appliances exist in the community.

b) The skills required to support the installation of all forms of wood burning appliances exist in Yellowknife or Rae Edzo.

c) No facilities for wood chipping presently exist.

c) No significant community infrastructure barriers exist to the success of a wood conversion program.

8. CONSTRAINTS TO WOOD CONVERSION

a) All buildings will require both wood and oil fired heating equipment to meet the occupants needs.

b) The impetus for saving fuel costs is not strong in many cases since the users are generally not the beneficiaries of energy savings.

c) The unfamiliarity of technical planners and government funding people concerning modern wood heating technology is an impediment to an owner seeking to convert to the primary use of wood fuel.

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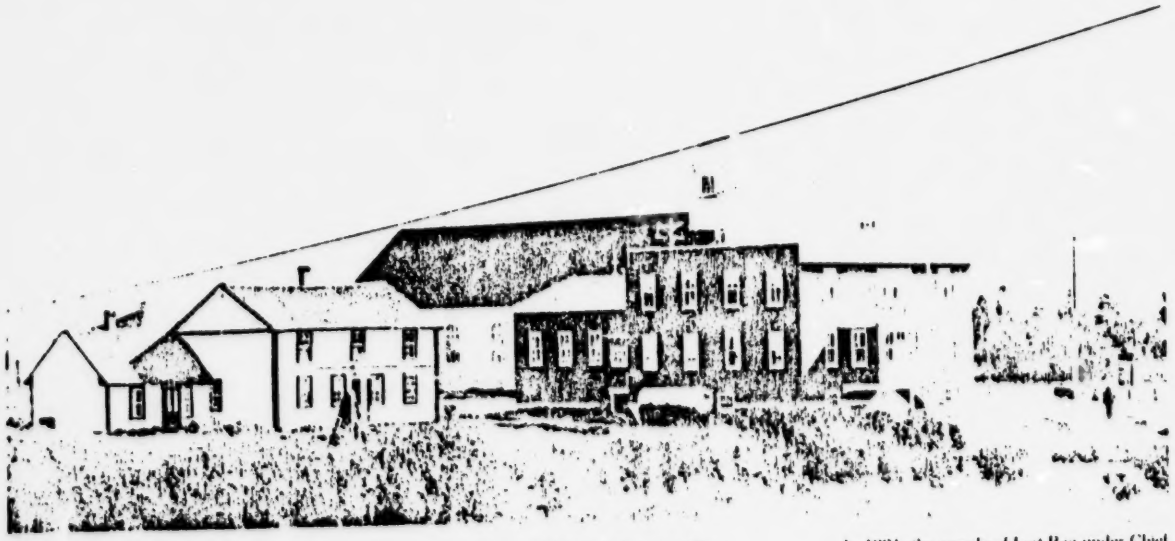
Appendix 1.0

DEMOGRAPHIC and INFRASTRUCTURE SUMMARY of RAE EDZO

Rae-Edzo 1982 (Ref. 5)

Source:

NWT Data Book 1982-83, published by: Outcrop Ltd., The Northern Publishers, Yellowknife, N.W.T., pages 122-123 reprinted with permission of the publisher



Location

62°50 N 116°03 W Elevation 513' at Marion Lake 70 air miles NW of Yellowknife, in the Fort Smith Region, Yellowknife area

On a peninsula in Marion Lake (Rae) and at the West Channel crossing (Edzo) into the North Arm of Great Slave Lake

Topography

On rocky, outcrop and silty clay terrain (Rae) and shale and sand (Edzo), in low lying rough timbered country

Climate

Average annual precipitation 14.4 cm rainfall, 1100 cm snowfall, 25.4 cm total precipitation
July mean high 20.4° C low 11.3° C
January mean high 23.4° C, low 32.0° C
Winds E at 8.9 knots

History

Rae Edzo is the largest Dene community in the Northwest Territories. The Dogrib people have lived in the Rae area for centuries, pursuing caribou and other game in small family groups until modern times. After about 1780 a trading post was established in the area. The Yellowknife Chipewyans had received guns prior to the Dogrib and effectively gained control of trade around Great Slave Lake. The Yellowknives oppressed the Dogrib for over 30 years, but in 1823 the Dogrib began to fight back and retake their old hunting grounds. The chiefs Akaitcho of the Yellowknives and Edzo, for whom the newer development at Rae is named, made peace.

In 1852, Dr. John Rae, the early explorer who more than any other adopted the indigenous way of life in his travels, established a Hudson Bay Company post at Old Fort Rae, approximately five miles from the present site. This area was near the path taken by the caribou migrating north and south. The Dogrib people began to go there to trade, and a fairly large settlement developed. By 1890 there were about 600 Dene trading in to Fort Rae. At the turn of the century, the Northern Trading Co. set up a post at the present site, the point where travel routes from traditional hunting areas converged. With their supply of fur effectively cut off, the Hudson's Bay decided to relocate to Fort Rae in 1904.

In 1921, the people of Fort Rae under Chief Mandzi accepted Treaty No. 11. Although the Dogrib people had previously been known as one of the hardest groups in the Mackenzie District, alcohol and diseases previously unknown had a devastating effect. After 1900, a doctor made an annual trip into the settlement, but at about that time, measles killed one in ten of the band. Tuberculosis raged, and in 1928, an epidemic of influenza unwittingly spread by the supply ship "Distributor" left so many dead that in many camps there was no one left alive to bury them. By 1940, many observers felt that the Dogrib people were on the road to extinction.

Fortunately this did not prove to be the case. As early as 1930, the Fort Rae Dogrib began to protest that their understanding of the Treaty appeared not to be the same as that of the Government. It was not until the 1940s that permanent residences were built. The Roman Catholic mission established a convalescent hospital in the community, and modern medical facilities became available at nearby Yellowknife, after the Second World War. In 1959 electricity was brought to Rae, and the cross road to the Mackenzie Highway was constructed in 1960. The population continued to alternate between bush and settlement living until well into the 1960s.

In 1965, the Edzo site, about 15 miles from Rae, began to be developed. This was done in order to provide adequate sanitation economically, as the terrain at Rae provides poor drainage. In 1971, the school at Rae was closed and a huge new school and hostel constructed at Edzo, under one of the first local Education Societies in the NWT. However, despite occasional outbreaks of dysentery and tuberculosis even in recent years, most of the community continues to reside at Rae, which provides better water access for fishing and hunting purposes.

With its large permanent population and depleted game resources, Rae in the past has had a chronic unemployment problem. As late as 1963, the per capita income of the Rae Dene was only $225, including government transfer payments, lower even than that of other Dene groups. However, the community has contributed several articulate spokesmen to the aboriginal rights movement. Today the local Dene Band and community council actively pursue local responsibility and community development and employment projects including a recently inaugurated office/shopping complex.

Demography

Population, December 1979: 1,367, 1971: 1,056

1978 sex distribution: 50.5% male, 49.5% female

1978 age distribution: 0-4: 17.7%, 5-14: 32.8%, 15-64: 44.9%, 65+: 4.6%
Approximate median age: 14
Females aged 15-49 as % of total population: 18.7%

1978 ethnic distribution: 91.3% Dene, 0.0% Inuit, 8.7% other

Languages spoken: Dogrib, English, French

Political Organization

Hamlet status, April 1, 1974

Mayor, Charlie Charlo

Community Council: J. Charlo, J. Magwi, F. P. Rabesca, J. Rabesca, J.D. Zoe, F. Blackduck, F. Blondin

Secretary Manager: Peter Andersson

Liquor Plebiscite: August 20, 1976 prohibition

Dene Band Chief, Joe Mapi, MLA James Wah Shee (Rae - Lac La Martre), MP David Nickerson, PC (Western Arctic)

Economy

Major Activities
Domestic fishing, hunting, trapping, local development projects

Banks
None. Service from Yellowknife

Co-ops
Ftsanch Co-operative Association Limited.

Renewable Resources
Fish: Grayling, Jackfish (Pike), Lake Trout, Ling Cod (Loche), Pickerel (Walleye), Whitefish

Game: Beaver, Black Bear, Duck, Fox, Lynx, Marten, Mink, Moose, Muskrat, Ptarmigan, Rabbit, Wolf, Woodland Caribou. 1977-78 estimated Caribou harvest: 3,400

Total number of trappers: 215 (1979-80)
Number over $600: 103
Total fur dollars: $241,150.84

Non-renewable Resources
Minerals: gold, uranium prospects. See Rae Lakes, Yellowknife

Tourism
Traditional games and dances. Arts and crafts. Dene beadwork and embroidery, moosehide and stroud jackets, etc.

Prices and Income
Income per capita, 1976: $1,407, deviation of -7.5% from Canadian average for the same year

Consumer prices, 1977-79: -.80 - 39% higher than Edmonton

Local Businesses
Air Dogrib (charter aircraft), Akaitcho Industries (building contractor), Eddie Koyina Woodcut (tug and transport (electrical contractor, wood contractor), Rabesca Enterprises (firewood contractor), Behrens Trucking (firewood contractor), Cansell Trucking (trucking contractor), Doug Austin Trucking (trucking contractor), Bob Ritchie Excavating, Rix Trucking (local trucking contractor), Army's General Store, Rae Cafe (cafe, grocery, gas), Fort Rae Crafts (sale of crafts), Rae Band (store, laundry, cafe, bakery), The Bay (general retail), Operation Heritage (sale of local handicrafts), Hannigan's Burger King (restaurant), Hoval Construction (contractors), J B Gas Bar (gas station)

Infrastructure

Power
NCPC (Area Office Yellowknife), hydroelectric power with diesel backup. 600 kW capacity. 1980 rates, Domestic Service (non-government): 5.0¢ kWh for the first 300 kWh per month, 5.7¢ kWh for all over 300 kWh per month. Commercial Service (non-government): 8.4¢ kWh. Domestic Service (government): 9.0¢ kWh for 1st 300 kWh per month, 8.3¢ kWh for all over 300 kWh per month. Commercial Service (government): 11.2¢ kWh

Water
Source: Rae: Marion Lake (polluted), Edzo: Great Slave Lake West Channel. Rae water supply since 1979 is flocculated, settled, filtered and chlorinated. Partially piped distribution system to taphouses, remainder on privately contracted truck system. Edzo is fully piped

Sanitation
Rae: majority uses bagged sewage, privately contracted. Honey bucket recycling facility planned with pithouse. Sewage hauled to lagoon 2 km E of Rae. Garbage dump 2.5 km along access road. Edzo: piped sewage system

Fuel
Gasoline, heating oil, diesel available

Transportation

Air Facilities
Ice. Services: fuel, Servicing: minor repairs. Operator: Hamlet of Rae Edzo. Charter service: Air Dogrib

Road
Mackenzie Highway system: NWT Highway Number 3. 10 km access road to Rae. Winter tote trail to Lac La Martre and Rae Lakes. Trucking services: several local. Bus: taxi: Army's Taxi

Communications

Postal code: Rae, X0E 0Y0. Service daily. Telephone: NorthwesTel, microwave to Edzo, land lines from Edzo to Rae, local and long distance. CBC Radio (low powered relay transmitter), community radio: CBC Television (Anik)

Protection Services

Police: RCMP 4 man detachment
Justice of the Peace: Eric Burke
Coroner: Eric Burke
Other legal and court services: North Slave Native Courtworkers Association, Violet Mackenzie

Fire department: volunteer 12 person brigade, hydrant system at Edzo, Rae: vehicle: 750 gallon tanker truck, Edzo: vehicle: 1,050 GPM 150 PSI pumper truck, call boxes

Medical/Social Services

Hospital: Nursing Station: 11 bed Rae Edzo cottage hospital, National Health and Welfare. Medical staff: one MD, 2 nurses, 3 aides. Other medical services: Edzo Public Health Centre: 3 nurses, 1 dental therapist

Social Services Facilities: Community Social Services off.

Education

School: Chief Jimmy Bruneau, K-9, Principal: J. Outram
Students: Grades K to 6 (P80-81): 280, Grades 7 and up: 141
Teachers: 22, with 1 half time and 7 classroom assistants

Local Education Authority: Rae Edzo Education Society
School year: July 28 - May 29

Vocational and Continuing Education: two students at AVTC, Fort Smith, resident adult educator

Housing and Accommodation

NWT Housing Corporation units (P81): 150, GNWT staff housing units: 10, Other residential (P79): 81

P79-80 GNWT construction costs: 2% higher than Yellowknife. Operation costs: $1.66 sq ft. Maintenance cost: $1.03 sq ft. Rae Edzo Housing Association

Recreation

Community centre: School gym, planned outdoor skating rink, baseball diamond, lake sports. Active Recreation Committee (Rae Edzo Education Association)

Appendix 2.0

RAE EDZO ENERGY USE

Appendix 2.0 RAE EDZO ENERGY USE

The following tabulated data provide information on the use of electicity, heating oil, and transportation fuels in Rae Edzo. The data is based on an annual estimate composed from individual monthly totals scattered throughout the 1978 - 80 timeframe. Justification for the population and fuel price projections were not stated by the source. The source document was: Hubert, B., et al, "Energy in the Northwest Territories - Preliminary Report", Science Advisory Board of the N.W.T., Yellowknife, N.W.T., October, 1980.

The fuel consumption totals are significantly lower than those compiled by this study. Significant omissions in the fuel data are apparent. The table is provided primarily as a single reference on electrical and other non heating fuel energy forms in the community.

Settlement : RAE-EDZO

Location : 62 50' N
116 3' W
Degree Days: 16,000 F
Population : 1,367

Housing:
Govt of Canada: -
Govt of NWT : 2
NWT Housing Co: 79
Private : -

Fuel Supplier:
Esso
Gulf

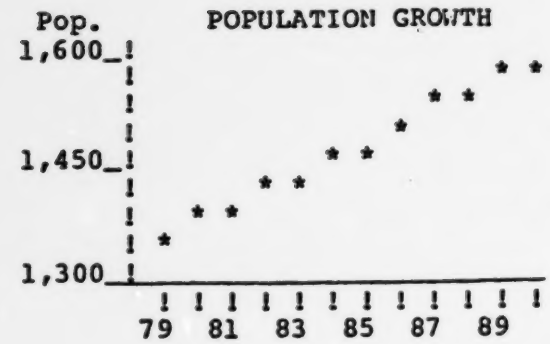
ANNUAL ENERGY CONSUMPTION

Sectors	Electricity	Heating Oil	Diesel Fuel	Motor Gasoline	Aviation Fuel	Turbo Fuel
	(000KWH)	(gal)	(gal)	(gal)	(gal)	(gal)
TOTAL	3,496	118,899	1,586	104,082	13,083	-
▲ Residential	1,674	40,432	-	-	-	-
• Government	1,422	40,432	-	-	-	-
Canada	-	-	-	-	-	-
NWT	-	-	-	-	-	-
NWTHC	-	40,432	-	-	-	-
• Private	252	-	-	-	-	-
▲ Commercial	1,785	78,467	-	-	13,083	-
• Government	1,437	66,855	-	-	-	-
Canada	-	7,973	-	-	-	-
RCMP	-	7,973	-	-	-	-
Health	-	-	-	-	-	-
Other	-	-	-	-	-	-
NWT	-	58,882	-	-	-	-
School	-	51,149	-	-	-	-
Local	-	7,415	-	-	-	-
Other	-	318	-	-	-	-
• Private	348	11,612	-	-	13,083	-
▲ Unidentified	37	-	-	-	-	-
	**********	Per Capita Consumption	**********			
	(KWH)	(gal)	(gal)	(gal)	(gal)	(gal)
TOTAL	2,557	87	1	76	10	-
Residential	1,225	30	-	-	-	-
Commercial	1,306	57	-	-	10	-
Government	1,051	49	-	-	-	-
Private	255	8	-	-	10	-
Unidentified	27	-	-	-	-	-

Data Source:
Electricity NCPC April, 1978 - March, 1979
Other Fuels Gulf - January, 1979 - December, 1979
Esso - June, 1979 - May, 1980

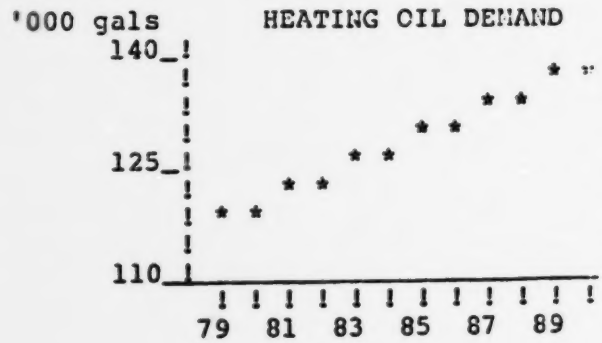
PROJECTIONS

FUEL STORAGE CAPACITY(GNWT):	
Heating Oil	- gal
Gasoline	- gal
ELECTRICITY:	
Producer	NCPC
Distributor	NCPC
Generating Cap.	600 KW
Total Generated	- KWH
Total Load	3,496,000 KWH
Peak Load	1,450 KW
Customers:	
Government	
Residential	178
Commercial	37
Private	
Residential	48
Commercial	11
Generating Fuel:	
Type	DIESEL
Consumption	- gal
Storage Capacity	- gal



CONSUMPTION IN GIGAJOULES:

TOTAL	52,578 GJ
Electricity	12,586 GJ
Heating Oil	21,351 GJ
Diesel Fuel	278 GJ
Motor Gasoline	16,371 GJ
Aviation Fuel	1,992 GJ
Turbo Fuel	- GJ
Natural Gas	- GJ
Propane	- GJ
TOTAL PER CAPITA	38 GJ



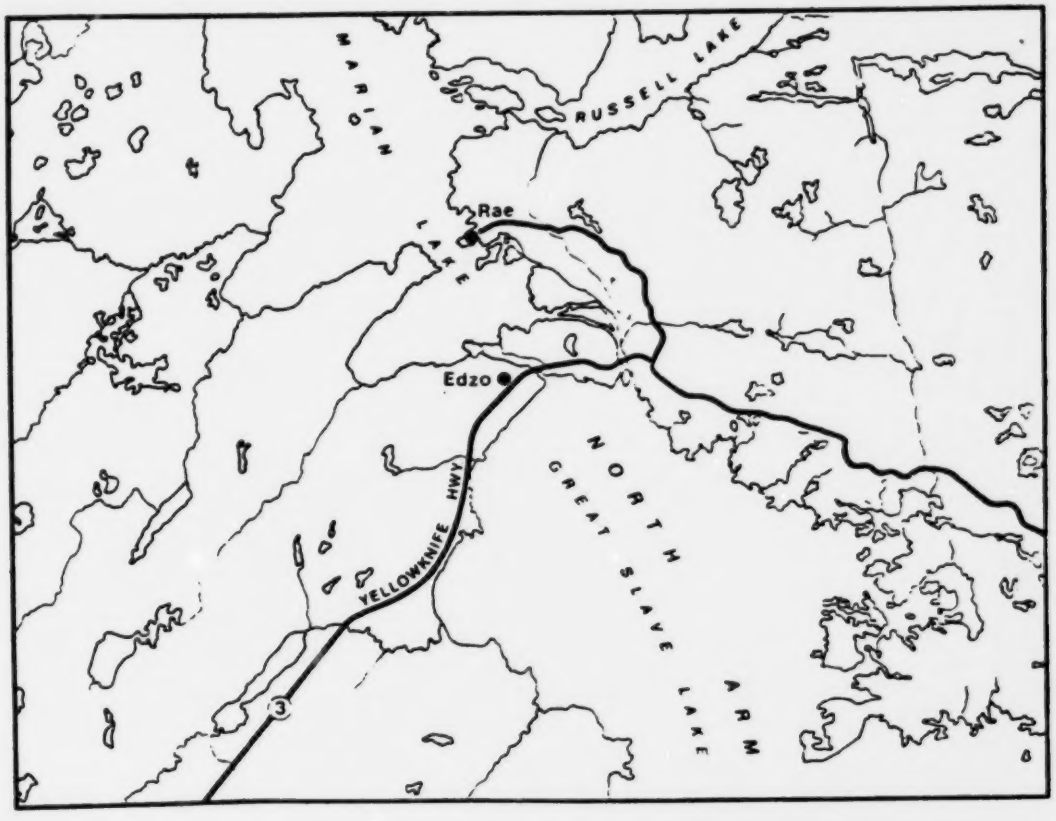
COMMENTS:
Supply Point: Edmonton
- Electric power supplied by Hydro with local diesel for back-up,

Appendix 3.0

RAE EDZO COMMUNITY LAYOUT PLANS

Northwest Territories Local Government

TOWN PLANNING AND LANDS



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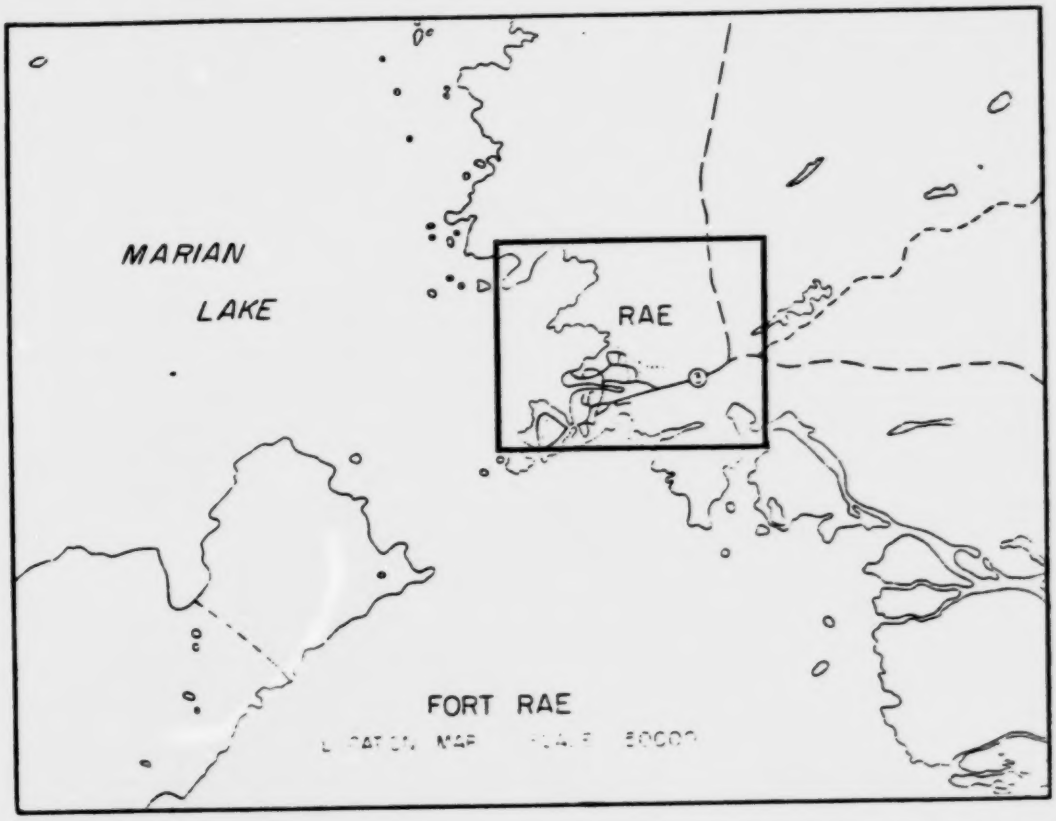
Northwest Territories Local Government

TOWN PLANNING AND LANDS



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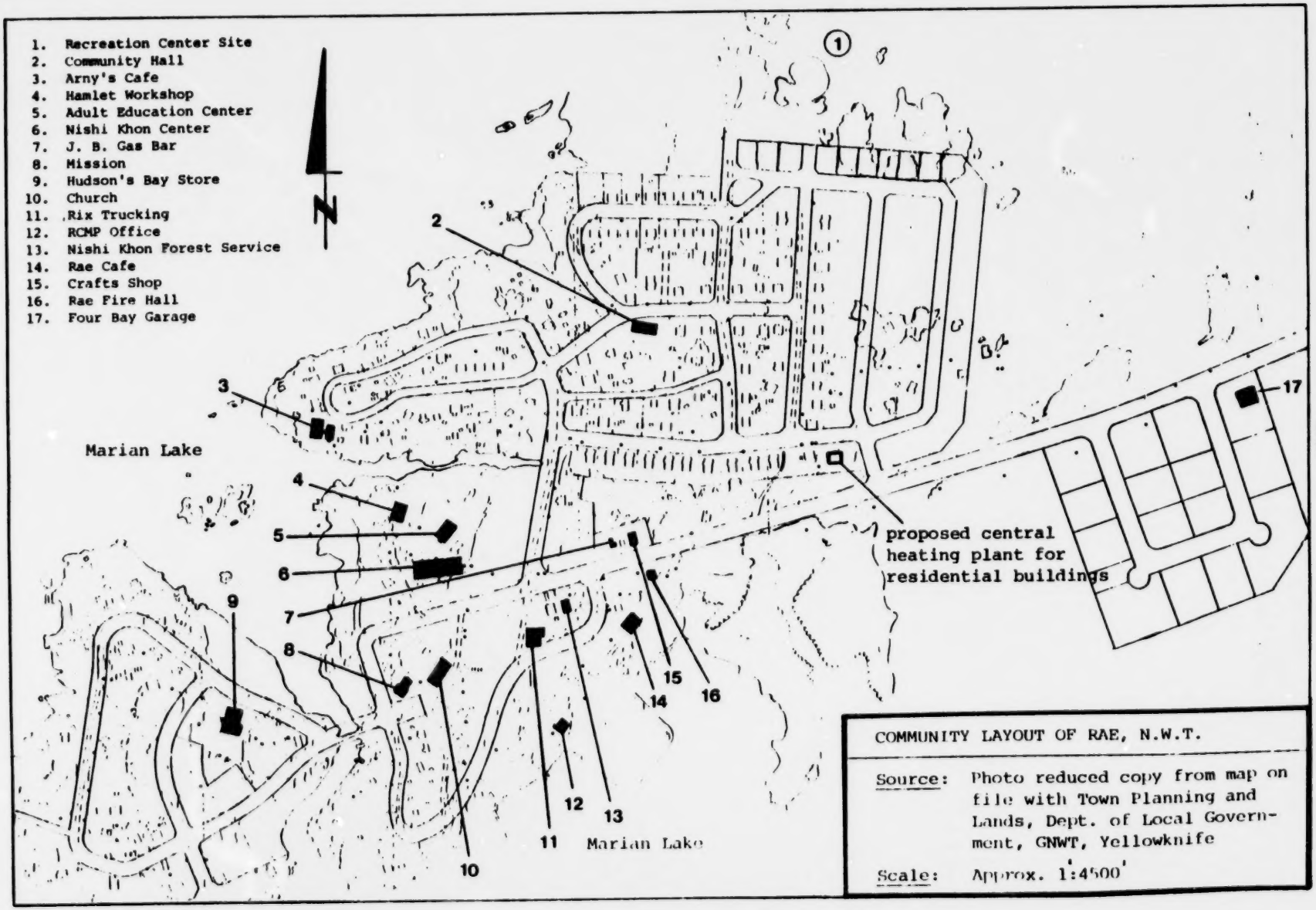
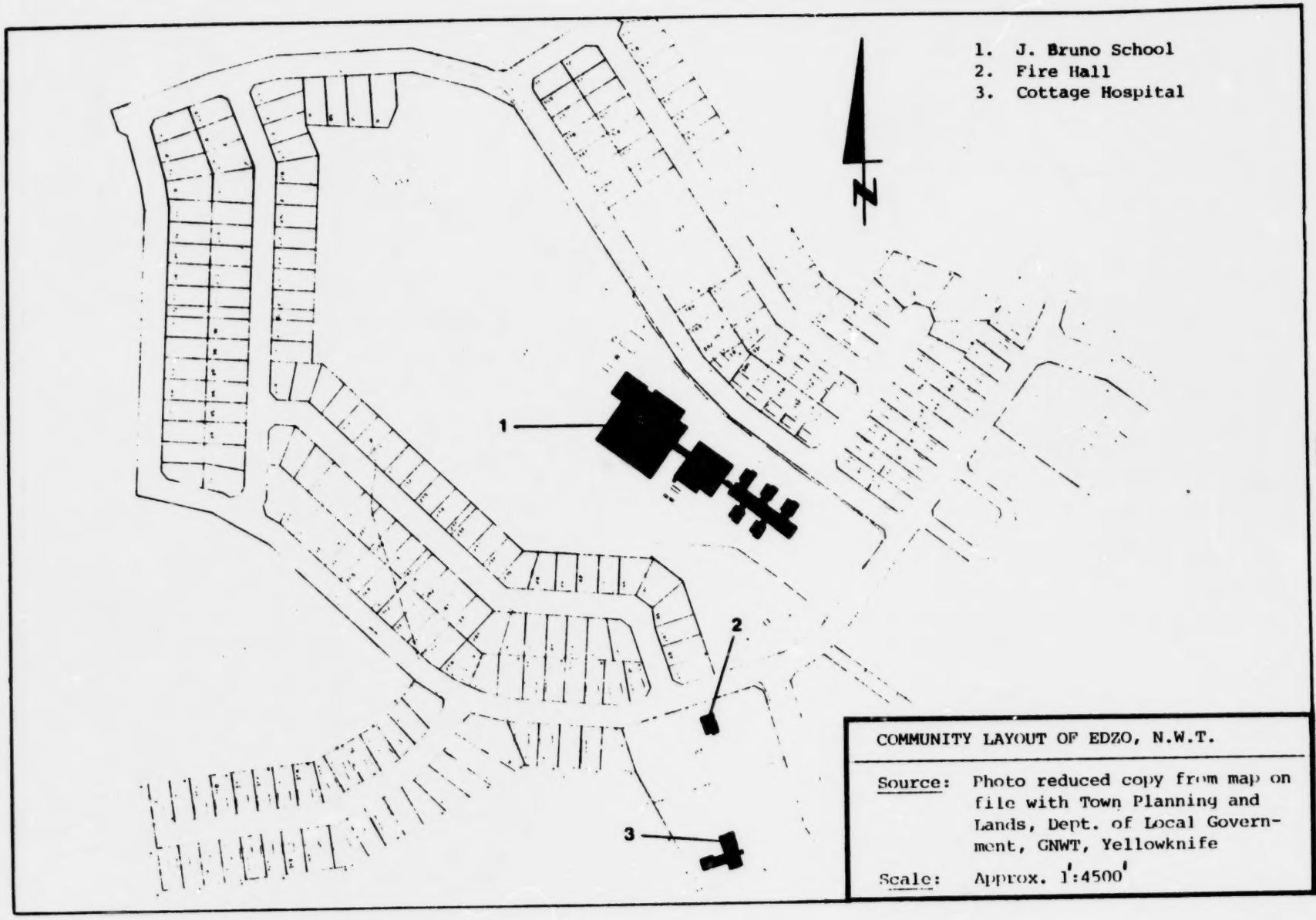


COMMUNITY LAYOUT OF RAE, N.W.T.

Source: Photo reduced copy from map on file with Town Planning and Lands, Dept. of Local Government, GNWT, Yellowknife

Scale: Approx. 1:4500'



COMMUNITY LAYOUT OF EDZO, N.W.T.

Source: Photo reduced copy from map on file with Town Planning and Lands, Dept. of Local Government, GNWT, Yellowknife

Scale: Approx. 1":4500'

Appendix 4.0

COMMUNITY BUILDINGS and HEATING SYSTEMS

APPENDIX 4.0

COMMUNITY BUILDINGS AND HEATING SYSTEMS

A4.1 GENERAL

A large proportion of the commercial and institutional buildings and heating systems in the Rae Edzo community were examined as part of this project. A representative sample of each type of residential dwelling was examined also. Descriptions of the buildings and dwellings visited are presented in this appendix.

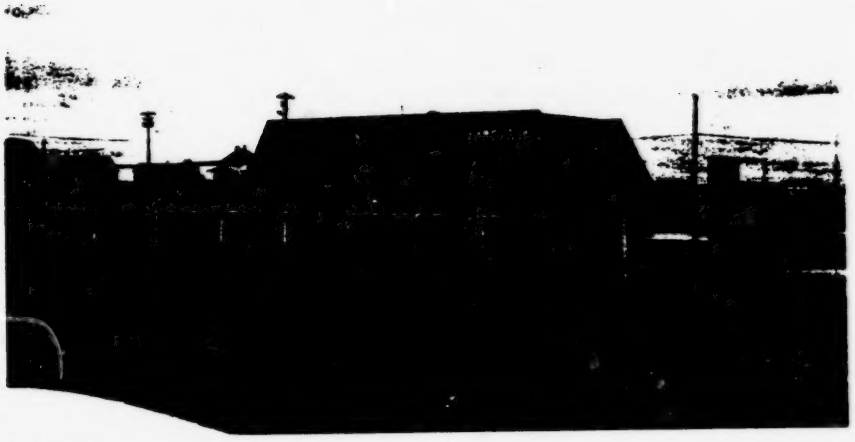
A4.2 COMMERCIAL

Eight commercial businesses were identified in the Rae Edzo community. Seven of their facilities were visited and five were closely examined for current heating equipment and wood heat change over requirements. In general, the operators of the businesses were not willing to solely rely on wood as a heat source and would elect to burn fuel oil if extra staff were required to stoke a wood burner.

The eight commercial facilities identified are:

- Arny's General Stores Ltd.
  owner: resident, Arny Steinwand
- Fort Rae Handicraft Centre
- Hudson's Bay Co., retail store
  owner: non-resident
- Nishi Khon Centre Commercial Complex
  owner: Rae Edzo Dene Band Development Corporation Ltd.
- Development Corporation Warehouse and Adult Education Centre
  owner: Rae Edzo Dene Band Development Corporation Ltd.
- Nishi Khon Forest Service Ltd., forest fire suppression
  owner: Rae Edzo Dene Band Development Corporation Ltd.
- Rae Cafe
  owner: resident, Arny Steinwand
- Rix Trucking
  owner: resident, Dan Marion
- J. B. Gas Bar
  owner: resident

a) Nishi Khon Centre



Description

The Nishi Khon Centre in Rae is the largest single commercial building in the community. The facility is a two storey frame construction building on a concrete foundation with space assigned to offices, cafeteria, food store, meeting room, beauty parlor, etc. The Centre has approximately 50,000 ft.^{3} of enclosed area overall. The Nishi Khon Centre was built in 1979 - 80. The Centre is owned and operated by the Rae Edzo Dene Band Development Corporation Ltd.

Heating System

The building is heated by two oil-fired hot water boilers located in a mechanical room on the ground floor. A 100 gal/hr. oil fired potable water heater is located near the boilers. Each boiler is a Weil-McLain model BL 686 fire tube boiler rated for 1,008,700 BTU/hr output at 15 psig (206 Kpa) working pressure. The heat is distributed by zone controlled hot water loops through baseboard convectors in the various rooms. The boilers were manufactured in 1980. The facility appears to be very well maintained. A full life expentancy of 40+ years for the equipment can be expected.

Requirements to Convert to Wood Heating

A complete self contained wood boiler facility would be required to convert the Nishi Khon Centre. The existing mechanical room does not have space to house a wood boiler. A building addition or a separate building must be constructed on the north east corner of the Nishi Khon Centre. Hot water produced by the wood boiler could be piped the short distance (40 - 50 m) to simply tie into the existing manifold to the hot water distribution loops (located in the mechanical room). It is assumed that the oil fired equipment would be retained for back-up service. A separate chimney, new wood handling facilities, ash collection and disposal equipment would be built into the new facility.

No technical problems to complicate the conversion process are expected.

b) Hudson's Bay Company

Description

The Hudson's Bay Company operate a retail store, manager's house, warehouse and staff house trailer in Rae. The retail store, built in the late sixties, occupies approximately 4,000 gross ft.^{2} on one level. The building is frame construction with metal siding, fixed on a concrete foundation. The building has no windows, and incorporates common energy conservation measures (a porch entry, insulated exterior siding, weatherstripping, etc.).

The manager's house, located 70 - 80 m from the store, is a 700 - 800 ft.^{2} wood frame structure with slate-like exterior siding. The trailer, located between the house and store, is approximately 30 ft. long by 8 ft. wide, fixed on a timber foundation. The warehouse is approximately 400 sq. ft. in area and located approximately 10 metres from the store. The warehouse is only partially heated. Decisions regarding wood fuel conversion would be made by Manager - MacKenzie River District, The Bay, 600 Principal Plaza, 10303 Jasper Avenue, Edmonton, Alberta, T5J 3N6.

Heating Systems

The retail store is heated by means of a Powermatic 250,000 BTU/hr. oil fired hot air furnace. A minimum of ductwork is employed to deliver the air to the store area. The furnace appeared to be in good condition. No operating problems were reported.

The manager's house is heated by means of an Olsen, Inc. 105,000 BTU/hr. oil fired hot air furnace. The buildings have oil fired furnaces also. The furnace is expected to last at least another 10 years.

Requirements to Convert to Wood Heating

The existing furnace in the retail store is situated in a small room with an exterior wall. A wood fired hot air furnace or hot water boiler may not fit in the remaining available space. The store would therefore require a small addition to be built to enlarge the furnace room to accommodate a wood fired heating appliance and perhaps a small quantity of wood fuel for handfiring the wood heating unit. A large wood fired hot air furnace may serve the need here, or a combination wood/oil furnace. A wood fired furnace could be arranged to supply hot air to the existing air ductwork. The existing oil fired unit and a wood furnace could be ducted in series. A separate chimney for the wood fired heater is required. Wood fuel handling and ash removal is assumed to be a manual operation.

The retail store is not inhabited 24 hours per day or seven days per week. Accordingly, a combination of wood heating and oil heating is most desirable for the store operator.

Hudson's Bay Co. are reportedly very sensitive to energy conservation practices and minimizing the store operating costs. The building appeared to be sound from an energy conservation perspective.

c) J. B. Gas Bar

Description

J. B. Gas Bar is a small gasoline sales outlet consisting of two above ground gasoline storage tanks, and a small (approx. 500 ft.^{2}) building for accessories sales, cashier, etc. The building is the converted shell of the former freezer building.

Heating System

The building is heated by a Moffat hot air furnace fitted with a 0.85 U.S. gal/hr. (3.22 litres/hr) oil burner (estimate at 110,000 BTU/hr). No air distribution ductwork exists. The chimney is in fair to poor condition. The furnace can be expected to last another 5 - 10 years.

Requirements to Convert to Wood Heating

An airtight stove may be suitable for this location leaving the existing oil fired equipment in place as a back up heat source. Conversion of this building to wood fuel should be approached with caution. The possibility for ignition of gasoline fumes, or ignition of oil products on the floor of the interior, may constitute a significant fire hazard during the manual restoking of a wood burner.

d) Rix Trucking

Description

Rix Trucking operates a vehicle maintenance shop and office space in a 55' x 25' metal clad building. Garage style roll-up doors provide access to the shop area. The office space is framed off from the shop, on one side of the building.

Heating System

The office is heated by a Lemax 0F4-259 oil fired hot air furnace (207,000 BTU/hr. output capacity), the shop area is heated by an owner built wood stove. The stove is a single pass dutch oven type boiler unit and is located in an adjacent room to the shop. Heat is radiated by the stove to the room (no water or air is circulated through the unit). Air vents are cut in the shop access door to promote natural convection of the heated air into the shop area. The owner estimated that the building heating cost was reduced by $2,000 - $3,000 in 1982 due to the use of the wood stove.

Requirements to Convert to Wood Heating

The building is already heated with wood to a significant proportion. The hot surfaces of the wood burner are isolated from shop area to reduce the chances for fire from contact with various flammable substances typically found in a vehicle maintenance shop. A complete, commercially packaged wood fired hot air furnace may yield significantly higher fuel efficiencies than the present wood heater arrangement. The furnace could be located in the existing wood stove room (the old one discarded) with air ducts running to the office area and into the shop.

The prospects for this form of conversion by this business are low. The business collects and sells fuel wood as a side line fill-in activity. The owner is pleased with the present arrangement, achieved essentially with no cost.

e) Development Corporation Warehouse and Adult Education Centre

Description

The Old Town Hall in Rae is now used for the adult education centre in the community and as a warehouse for small equipment, dry goods, some materials, and other property owned by the Rae Edzo Dene Band Development Corporation Ltd. The wood frame construction building encloses approximately 2500 ft. The structure, built in the 1950's rests on a concrete foundation and has a partial basement, used to locate the heating system.

Heating System

The building is equipped with two oil fired hot air furnaces and an air duct distribution system. The furnaces are located in the basement in a large room adjacent to an outside wall. The room is large enough to house replacement wood fired furnace equipment (with fuel handling and chimney facilities to be located outside). The present furnaces are Olsen Inc. model BCC125, 125,000 BTU/hr. oil fired hot air furnaces. The furnaces share a common chimney flue. The equipment is in good condition, suggesting a remaining lifetime of 15+ years.

Requirements to Convert to Wood Heating

This building could be fitted with a large wood fired furnace with the heated building air ducted into the oil furnace return air duct. The unit could be located in the same room as the present oil fired equipment. A wood fuel feed system or split wood for manual stoking could be supplied through the presently closed off coal chute into the room. A new chimney flue is recommended.

Owing to the proximity of this building to the Nishi Khon Centre, a centralized wood boiler facility serving these loads (common owner) and the nearby Hamlet workshop may be economical.

A4.3 INSTITUTIONAL AND MUNICIPAL BUILDINGS

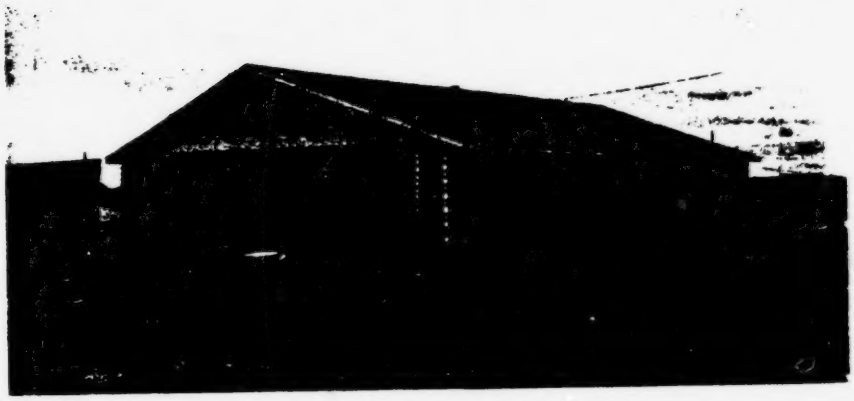
The Hamlet of Rae Edzo own and operate a number of shops, garages and other buildings on behalf of the community. Hamlet administrative offices are located in the Nishi Khon Centre commercial complex in Rae. The major institutional buildings are located in Edzo, including the school and the hospital. All existing facilities in this class are heated with fuel oil.

A number of new buildings, planned for construction in the next few years, were identified. These buildings will likely be located in Rae. Wood fired heating systems may be designed into each of these new facilities, except for the Rae Recreation Centre, under construction in the April to September 1984 time frame. An oil fired heating system is specified for this complex.

The individual institutional and municipal buildings identified in the Rae Edzo community are listed below:

- Rae Edzo Hamlet Owned Buildings
  - Hamlet Workshop (log building NW of Nishi Khon Centre), Rae
  - Old Community Hall, Rae
  - Four Bay Equipment Garage, Rae
  - Firehall, Edzo
  - Firehall, Rae
  - Secretary Manager's house
- Royal Canadian Mounted Police Facilities
  - Detachment Office, Rae (1800 $ft.^2$)
  - N.C.O. House, Rae (1200 $ft.^2$)
  - Workshop, Rae
  - Duplex housing accommodation (2 x 1200 $ft.^2$)- Rae
  - Double wide house trailer (1680 $ft.^2$) - Rae
  - House trailer, Edzo (840 $ft.^2$)
- Jimmy Bruneau Elementary School, Edzo
- Cottage Hospital
- Roman Catholic Church and Mission
- Future Old Folks Home
- Future Recreation Centre Complex
- Future Rae Elementary School

a) Hamlet Workshop



Description

The workshop is single storey building of log construction with a conventionally finished interior and conventional truss roof (the inside of the log walls are finished with plywood sheeting). The main floor is a few steps above grade, with the crawl space under the building closed off by plywood skirting. The building gives the impression that relatively high infiltration exists. The workshop is used for plumbing, carpentry trades, for trades training on occasion and storage. The building is not frequently inhabited.

Heating Systems

The building is heated with an Olsen, Inc. 161,000 BTU/hr oil fired hot air furnace. The furnace and chimney are located in the middle of the building on the main floor. A simple ceiling mounted duct system is used to distribute heat to the four major rooms in the building. The furnace is in good condition and can be expected to operate for 15+ years.

Requirements to Convert to Wood Heating

Plenty of space exists within the building enclosure to locate a new wood burning appliance. A wood fuelled hot air furnace may best be located on the north wall or north west corner. This will require a modification to the exterior wall to facilitate wood fuel entry. Extra air ducting would be required to tie in the wood furnace to the existing duct distribution.

b) Community Hall

Description

The community hall in Rae consists of a large open dance floor area, a stage area, a concessions area and storage or lounge space above the concession. The building is approximately 80' x 35' in plan dimensions. The hall is a wood frame construction building resting on a concrete foundation. The structure is in fair condition and could benefit from face lifting type repairs, and weather stripping hall doors etc. The building has a steep pitched roof.

Heating System

The building is fitted with two oil fired hot air furnaces, located on the main floor near the entrance. One furnace is an Olsen, Inc. 110,000 BTU/hr. unit; the second is an Olsen, Inc. 123,000 BTU/hr. unit. The furnaces supply hot air to ductwork running along the floor on each side of the hall. The furnaces share a common insulated metal chimney. The insulation is in need of repair. The heating system, and the building may have another 10 years of useful life.

The building is normally used for one or two four-hourly periods per week to hold a dance or other community event. The building temperature is significantly reduced during the periods of inactivity and is increased just before the scheduled event.

Requirements to Convert to Wood Heating

A large wood fuelled hot air furnace with a new chimney flue would be required for this facility. However, due to the low frequency of use of this building, conversion to wood heating is not recommended.

c) Four Bay Equipment Garage

Description

Heavy equipment used by the Hamlet for municipal works (grader, loaders, hauling trucks) are stored and maintained in the new Hamlet garage in Rae. The 70' x 50' facility was built in 1979 and features four 19' wide roll-up doors for vehicle entry. The building is steel frame construction with 16' walls and a 22' high peaked roof. The walls are insulated and have a steel clad exterior. The interior is partitioned into two halves with a concrete block partition wall. One half has a concrete floor, the second half has a gravel floor.

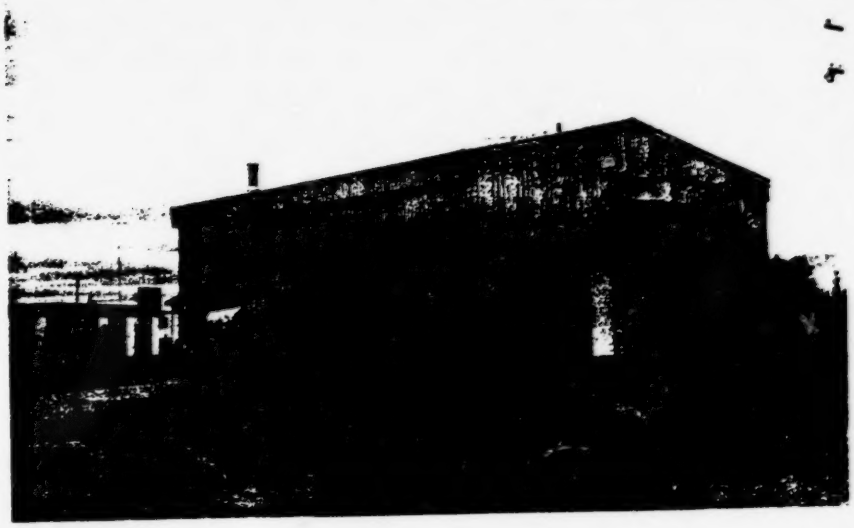
Heating System

Each half of the interior is fitted with a pair of overhead suspended oil fired hot air furnaces. Fuel oil is supplied to each of the four furnaces by means of a small fuel pump and flow lines from a fuel supply tank. Propeller fans in each furnace project hot air directly into the building space (no duct work). The furnaces are manufactured by Powrmatic. A 100,000 BTU/hr and a 180,000 BTU/hr unit are installed in each half of the building. The temperature in the building is kept in the 15^{o}C range or less as convenient providing an acceptable work environment. The building is infrequently inhabited.

Requirements to Convert to Wood Heating

A small wood fired hot water boiler (500 - 600,000 BTU/hr) may be most appropriate for this facility. The water could be pumped to radiant heaters installed in each of the partitions. The space exists within the building to install a simple system. Some form of automated wood fuel supply system would be desirable, since the building is infrequently inhabited. The fuel stoker may need to be located inside to prevent sabotage of the heating system.

d) Firehall, Rae



Description

The firehall is a steel frame construction building, erected in 1981 to house the Hamlet fire truck and related fire fighting equipment. The interior layout of the 32' x 44' building includes garage space, two store rooms, a small washroom and mechanical room (furnace and water tank). The building has a concrete floor, a roll-up steel door for vehicle entry and has insulated steel clad walls and roof. The facility is generally uninhabited.

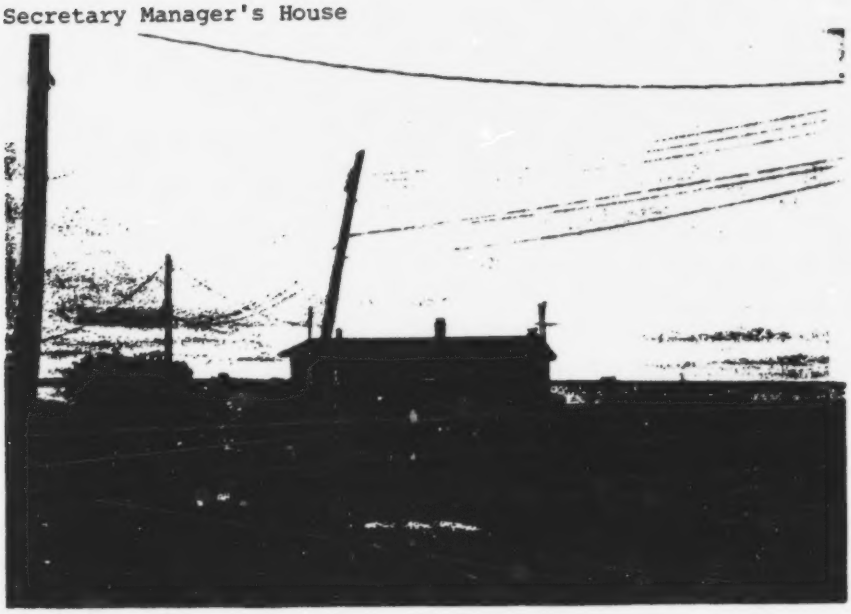
Heating System

The building is heated with an Olsen, Inc. H7L115A, 115,000 BTU/hr. oil fired hot air furnace. A simple duct system is used to convey air to the storage and garage areas. The furnace and the building in general are in immaculate condition. The temperature in the building is kept low (but above freezing) to conserve energy.

Requirements to Convert to Wood Heating

Part of the storage room area would need to be taken over to house a wood fired hot air furnace. Access to both an exterior wall (for wood fuel supply) and to the existing furnace (to tie in to the heat distribution ducts) is convenient from the adjoining storage room. A separate chimney flue is advised. Since this building is located some distance away from many other buildings, is not generally inhabited, only partially heated, and contains a new heating furnace, this building is not a prime candidate for wood heating conversion.

e) Secretary Manager's House



Description

The hamlet provides a single storey, approximately 900 ft.^{2} wood frame construction house for the secretary manager. The house is in very good condition with exterior walls recently fitted with rigid insulation on the exterior. Actions to minimize air infiltration have been taken including doorway weather stripping, sealing window casings, etc. The crawl space under the house is plywood skirted.

Heating System

The heating system consists of an Olsen, Inc. oil fired hot air furnace with an output capacity of 108,000 BTU/hr. Heat is distributed by insulated ductwork running in the crawl space under the floor. The furnace is located in a small utility room near the front door, with access to an outside wall. The furnace is quite new and can be expected to operate at least for another 15 years. A small pot belly wood burner stove is located in the main bedroom and is occasionally used for night time supplementary heating.

Requirements to Convert to Wood Heating

The house is quite compact, with little opportunity to place an airtight stove in a vacant spot. Without significantly reducing living room or kitchen space an addition to the living space may be most appropriate to include room for an airtight stove. Alternately, a combination wood/oil furnace could be substituted for the present oil furnace.

f) R.C.M.P. Facilities

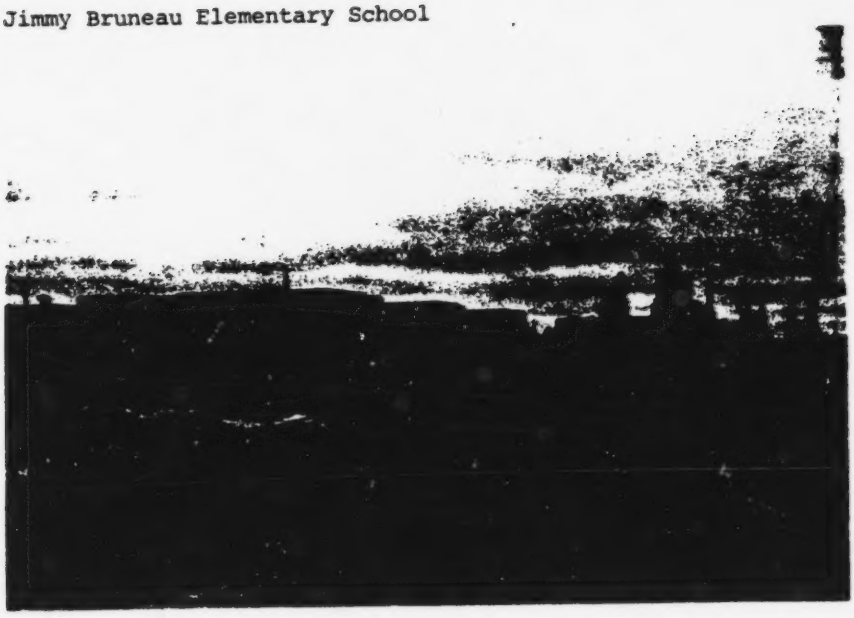
General Description

The various RCMP facilities include the detachment office, workshop and officers quarters. Most of the facilities are clustered at one location in Rae. The buildings are all wood frame construction with some facilities consisting of modular or mobile home style housing. A list of the RCMP buildings and their approximate sizes is included in the beginning of this section. All buildings are heated with fuel oil fired hot air furnaces. Some of the buildings (all except the NCO house) at the Rae detachment office site are tied together with a utilidor to distribute power and water. The detachment office was the only building visited. The single storey office is a modern, well maintained facility enclosing an area of approximately 36' x 48'. The facility was built in 1978.

Requirements to Convert to Wood Heating

Due to presence of the utilidor, a central wood fired boiler unit may be suitable for the location, serving all heating loads. The boiler may be situated in the workshop. Heat transfer coils could be installed into the existing oil furnace supply plenums, or separate hot water supplied radiant heaters may be installed in each building. Other possible conversion actions include the installation of airtight stoves or wood fired hot air furnaces separately in each building.

g) Jimmy Bruneau Elementary School



Description

The Jimmy Bruneau School in Edzo is the largest single building complex in the Rae Edzo community. The modern full service facility provides kindergarten to 9th grade education to children from Rae, Edzo and some surrounding small communities. The 60,000 ft.^{2} single storey complex contains 12 classrooms, workshops, full size gymnasium, large dining hall, library, special subject rooms, eight bedroom/sleeping accommodation, laundry facilities, administrative offices, local radio station, etc., and a hostel wing providing live-in accommodations for 100 students and a supervisors suite. The school enrolment is typically 450 students. The school was constructed in 1971 - 72.

Detailed fuel consumption records have been maintained by the boiler operating staff. The records clearly show the benefits of energy conservation initiatives taken in the late 1970's. Changes in operating practises were made, including reduction in fresh air intake, modifications to duct work, etc. The changes reportedly cut fuel oil consumption in half, resulting in significant excess capacity in the existing boiler facilities.

Heating System

The school is heated by a complement of oil fired hot water boilers. Heat is delivered throughout the complex by hot water distribution loops through baseboard convectors in each room. The heating equipment consists of:

a) unit B1 - NWT Reg. #1167

Cleaver Brooks Model CB-125
packaged hot water boiler
4,184,000 BTU/hr. output capacity (125 B.h.p.) @ 30 psig.
45 U.S. gal/hr. oil firing capacity

b) unit B2 - NWT Reg. #1166

Cleaver Brooks Model CB-125
as above

c) unit B3 - NWT Reg. #1168

Chromalox electric boiler
50 B.h.p. - 1,725,000 BTU/hr. output capacity

d) unit B4

Cleaver Brooks Beaver Boiler
2,400,000 BTU/hr. output capacity
primary domestic hot water heater

The equipment is operated in various configurations depending on the heating season. Unit B4 is operated to serve both domestic hot water heating and space heating loads in the spring and fall. Units B1 and B2 are operated in the coldest months. Either of units B1 or B2 is capable of carrying the school heating load on all but the coldest days. Unit B3 is rarely used. The boiler mechanical room is located in the middle of the elongated school complex. The room has access to an outside wall.

The boiler facility is operated by a qualified stationary engineer and an apprentice, on a 40 hr./wk basis. The boiler equipment appears to be well maintained and could be expected to function for another 20+ years.

Requirements to Convert to Wood Heating

A wood fired hot water boiler could be added to the system to carry the heat load on all but the coldest winter days. Two approaches are possible. The potentially cheapest and boldest approach would be to remove an existing Cleaver Brooks CB-125 boiler and replace it with a wood fired unit of similar size.

Alternately, a separate building may be erected to house a wood boiler, adjacent to the existing mechanical room, and full oil fired back up is retained. In any case, the wood boiler should be equipped with automated fuel stoking equipment since operators are not in continuous attendance.

A separate chimney flue for the wood boiler is assumed if a Cleaver Brooks boiler is not substituted. Modifications only to the existing flue gas venting arrangement may be possible if a boiler substitution is made.

CHIEF JIMMY BRUNEAU SCHOOL

ENERGY CONSUMPTION

HEATING SEASON REPORT (Aug. 1 to July 31)

YEAR	FUEL OIL	FUEL COST $/L.	AVERAGE TEMP.	ACTUAL COST
1974 - 1975	586,002.0 Litres	.1164/L	-6.2°C	$ 68,210.63
1975 - 1976	611,965.7 Litres	.1164/L	-6.4°C	71,232.81
1976 - 1977	483,734.4 Litres	.126/L	-3.8°C	60,950.53
1977 - 1978	377,924.9 Litres	.141/L	-4.7°C	53,287.41
1978 - 1979	280,406.8 Litres	.149/L	-6.6°C	41,780.61
1979 - 1980	223,625.5 Litres	.1875/L	-4.1°C	41,929.73
1980 - 1981	219,350.0 Litres	.2495/L	-4.8°C	54.727.83
1981 - 1982	236,416.3 Litres	.32826/L	-7.5°C	77,606.13
1982 - 1983	272,068.1 Litres	.37843/L	-7.5°C	102,958.63

POWER

YEAR	ENERGY	RATE ($/kwh)	ACTUAL COST
1976 - 1977	1,012,800 kwh	.063	$ 63,806.40
1977 - 1978	1,025,600 kwh	.08368	85,822,21
1978 - 1979	1,034,600 kwh	.09683	100,180.31
1979 - 1980	768,24[illegible] kwh	.10472	80,450.09
1980 - 1981	657,120 kwh	.1205	79,182.96
1981 - 1982	616,960 kwh	.1523255	93,978.79
1982 - 1983	633,280 kwh	.1680587	106,428.25

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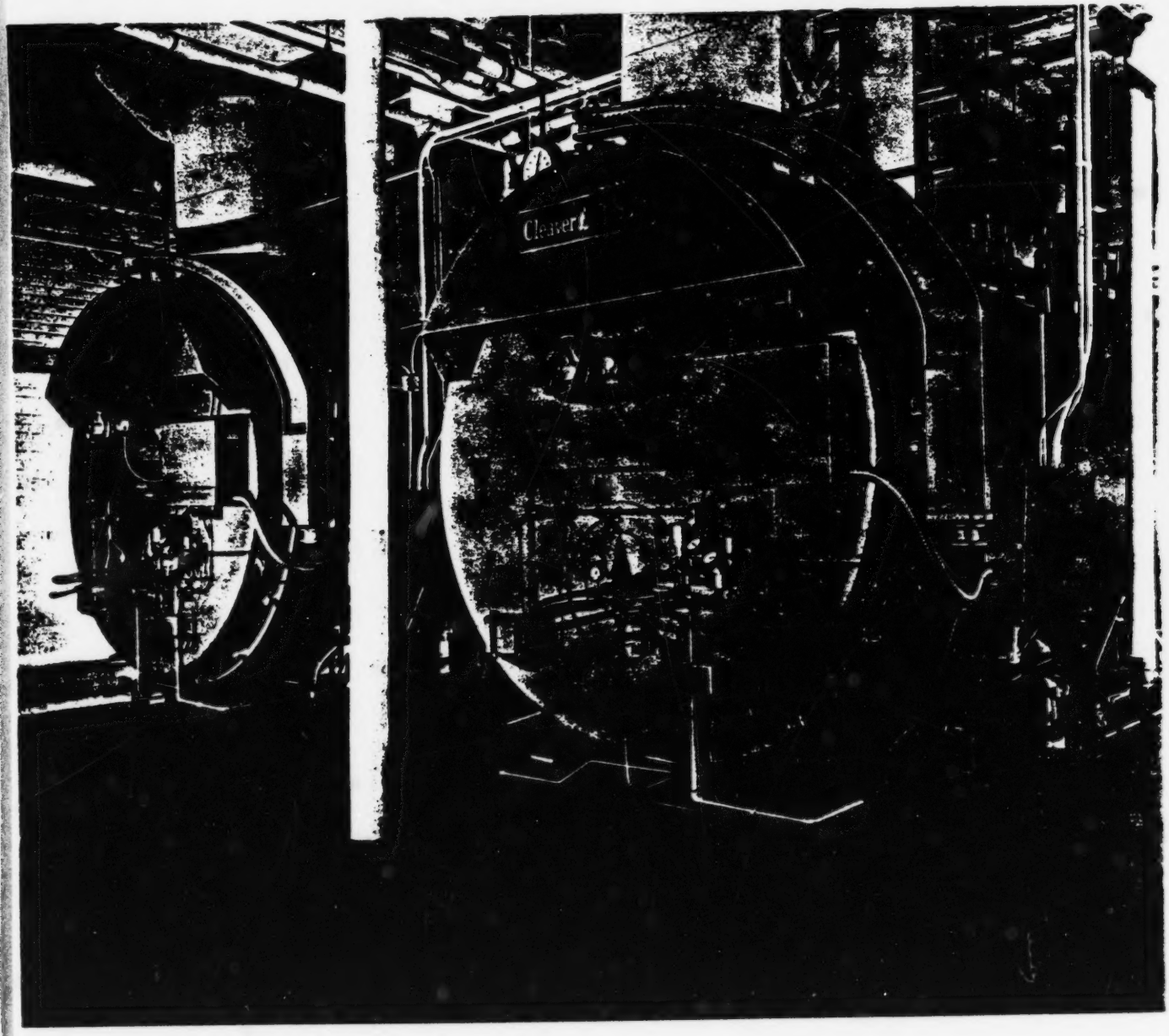
- For Heating or Processing
- Steam or Hot Water



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- Conserve Oil and Gas with Cleaver-Brooks Boilers!

Standard of Excellence established through

CB DESIGN CRITERIA

- SAFETY
- RELIABILITY
- EFFICIENCY
- EASE OF OPERATION

oil, gas, combination oil/gas fired...sizes through 800 hp...steam 15-250 psi...hot water, 30 lbs. and up

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The CB packaged boiler offers many practical advantages for the user.

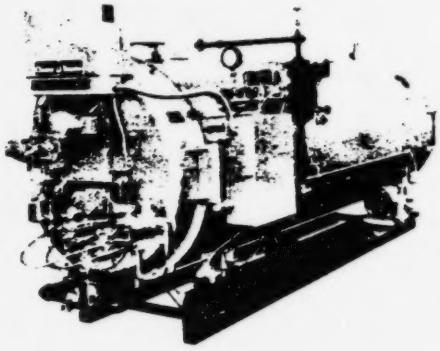
The CB boiler is a package consisting of a pressure vessel, burner, controls, draft fan, draft controls and other components assembled into a fully factory fire-tested unit. Components are selected to work together for maximum safety, highest efficiency and dependable operation.

Every model is thoroughly pilot tested and field proved as a unit before it is released. Every unit is performance tested in the factory before shipment. The boiler is pre-engineered and complete . . . ready for quick installation and connection to service lines.

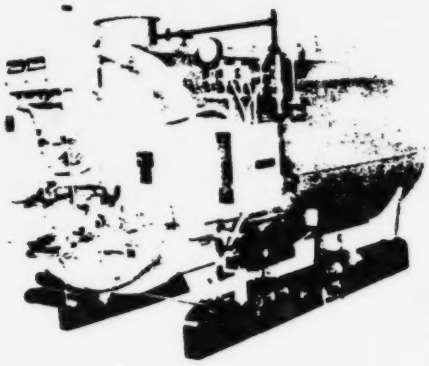
Underwriters' Laboratories lists the complete unit (not just the burner).

A built-in forced draft system provides all air for combustion. It is noted for its quick response to fluctuating loads. After the CB package is installed it is started and adjusted under customer's load conditions. A single manufacturer—Cleaver-Brooks—backs the entire package.

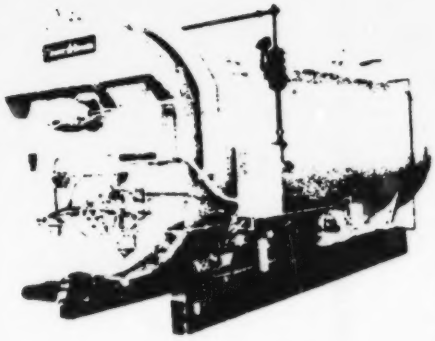
Cleaver-Brooks originated the packaged concept in 1931. Today, more buyers continue to choose Cleaver-Brooks in preference to all others — a preference which says, "Your best buy in packaged Steam and Hot Water boilers is Cleaver-Brooks."



Light Oil and gas fire CB Rated 5[illegible] HP



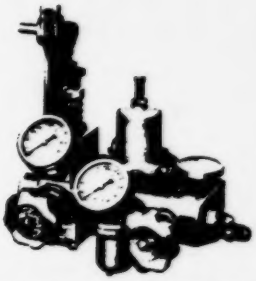
Heavy Oil and gas f[illegible] CB Rated [illegible] HP



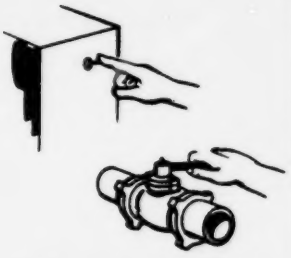
Heavy oil and gas fi[illegible] CB rated [illegible] HP

12 *good reasons why Cleaver-Brooks is your best buy...*

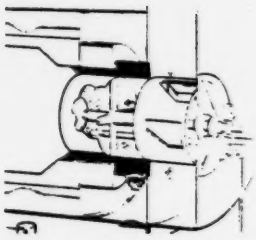
QUIET OPERATION — caseless fan guarantees quiet operation. Cast aluminum impeller with backward curved blades supplies combustion air. Direct-drive, no V-belt or special bearings.



FUEL OIL CONTROLLER — combines in one steel casting, gauges, regulators and valves needed in the integral fuel oil control system. Eliminates over 40 connections.

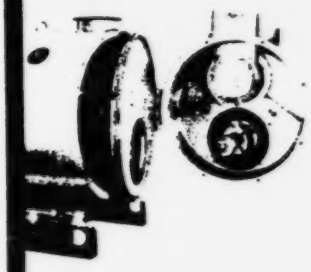


FUEL CHANGEOVER IN SECONDS — combination units, fired either with oil or gas can be changed over in less than a minute . . . no parts to remove or replace.

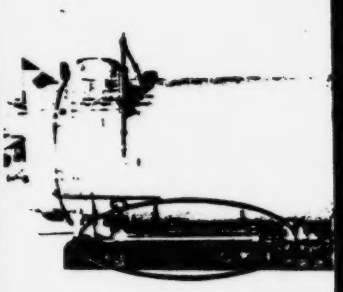


LOW COST FUEL CONVERSION — oil-fired CB can be equipped with gas burner rings and tappings for simple, quick conversion to gas firing at some future date.

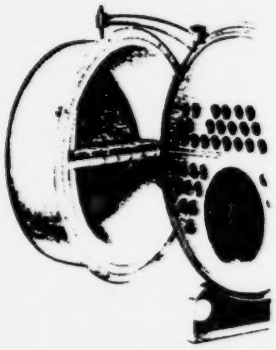
ECONOMICAL OPERATION — variable contour cam is adjustable to meter oil or gas for precise air-fuel ratios. This means economy you can count on.



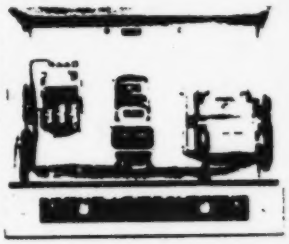
EASY TO INSPECT — front and rear doors are hinged or davited and swing open for quick inspection or cleaning. Cuts maintenance time from hours to minutes. No need to break oil or electric lines.



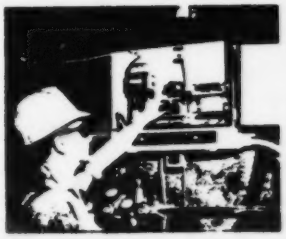
COMPACT STEAM AND ELECTRIC OIL PREHEATER — supplied on boilers using No. 6 oil. Reduces piping and radiant heat losses found in separate steam and electric oil heaters.



EASE OF MAINTENANCE — durable, high-temperature refractory installed in rear door. Door swings out for quick inspection or maintenance.

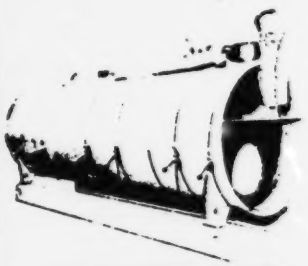


U.L. SAFETY APPROVED — plug-in modules allow conversion to other fuels without rewiring control panel. Operation of boiler is automatic.



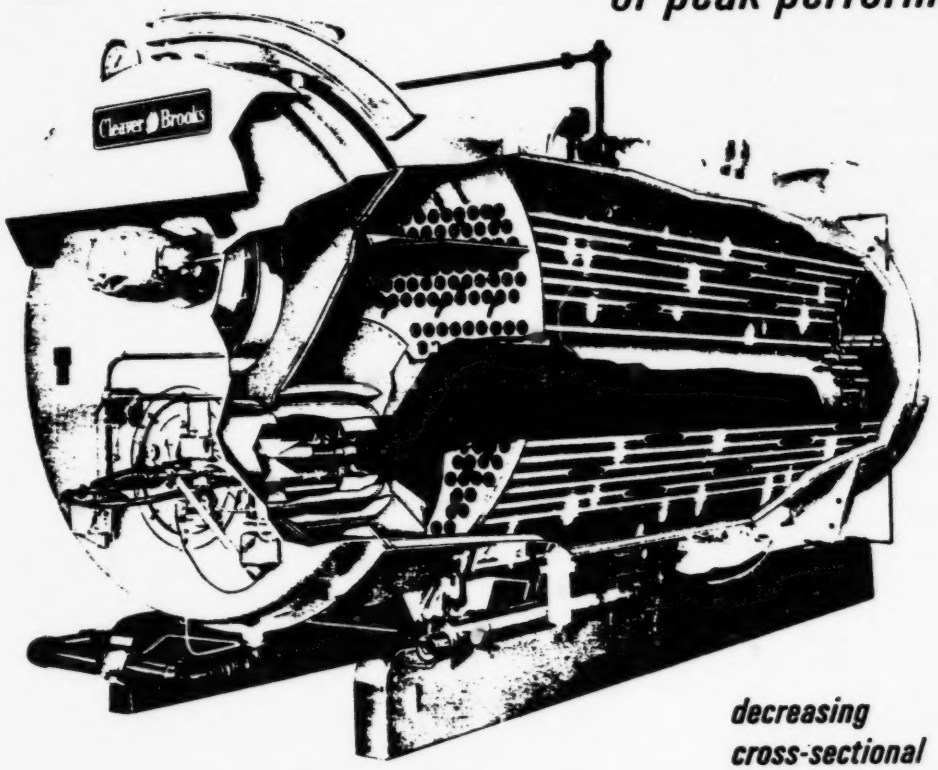
PROVEN "READY" BEFORE SHIPMENT — factory test proves your unit ready for efficient performance. Includes firing and checkout of controls.

QUALIFIED ASSISTANCE FOR START-UP— a trained Cleaver-Brooks serviceman starts your CB, adjusts it for your fuels and loads, and trains your operator.



INSULATION REDUCES HEAT LOSS — a non-settling moisture and heat-resistant 2" blanket of fiber glass insulation is covered with metal lagging.

4 DESIGN STANDARDS...*your guarantee of peak performance!*



1 FOUR PASS DESIGN

maintains high flue gas velocity for high heat transfer...greater operating economy

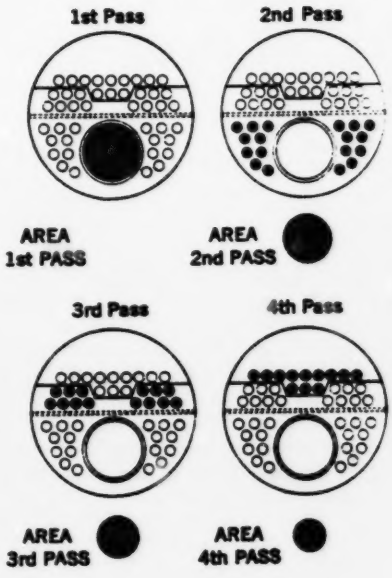
Advantages of the four pass principle used by Cleaver-Brooks is expressed in a simple basic formula:

$$\text{Gas Velocity} = \frac{\text{Gas Volume}}{\text{Area}}$$

CB models maintain a continuously high flue gas velocity essential to good heat transfer. As hot gases travel through the four passes, they transfer heat to the boiler water, then cool and thus occupy less volume. The cross section of gas flow area (number of tubes) is reduced proportionately to maintain high gas velocity, and produce constant and complete heat transfer.

Rapidly moving gases through the four passes of the CB scrub the tube surfaces clean and increase the heat transfer by improving the gas film coefficient. Every square foot of tube surface becomes more effective in transferring heat to the water. The ultimate result: excellent overall efficiency proven with low temperature combustion exhaust gases.

decreasing cross-sectional area of each pass maintains high flue gas velocity

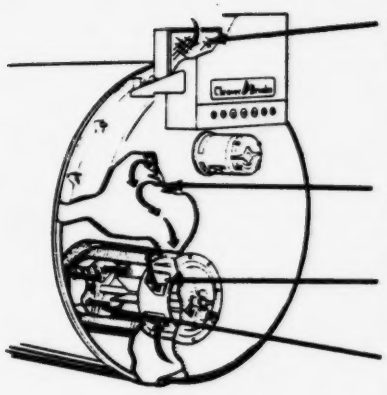


FORCED DRAFT DESIGN

provides air in required quantity at proper pressure

Improved Combustion — The forced draft system on the CB supplies controlled quantities of cool, clean boiler room air—air of constant density and volume. It assures proper mixture of air and fuel for complete combustion with little excess air. The forced draft fan supplies combustion air at required pressure and eliminates need for large diameter breeching, high chimneys, induced draft fans, barometric dampers, and sequencing draft controls.

Better Fan Performance with Less Maintenance — Fan moves fresh boiler room air instead of hot, corrosive exhaust gases. Notice how combustion air is directed through the front head and forms a chamber of air between boiler and burner, keeping the burner and controls cool. Air is then directed through a diffuser plate in a controlled pattern and mixes thoroughly with the fuel. Metering of fuel and air is completely automatic in response to your load demand.


Air Inlet: Short, direct, vibration-free — and accoustically lined.
Ceeless Fan: Quiet, maintenance-free, never needs cleaning.
Air Inlet Chamber: Assures uniform air pressure.
Diffuser: Directs air stream for complete fuel-air mixture.

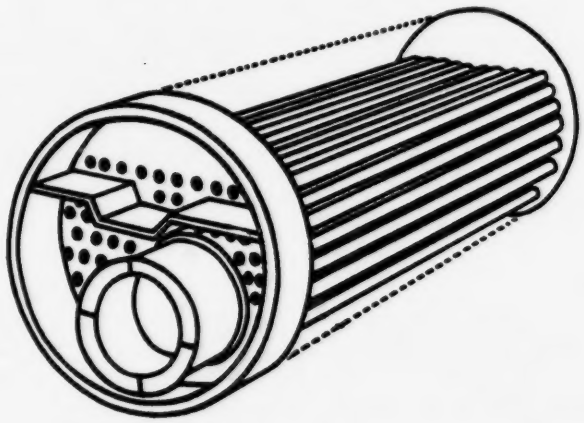
FIVE SQUARE FEET OF HEATING SURFACE PER BOILER HORSEPOWER

longer life with less maintenance

Heat transfer is the key to efficient and long lasting equipment. Cleaver-Brooks firetube systems are noted for their ruggedness and ability to handle varying load conditions. With their realistic approach to heat transfer rates CB systems offer long years of continuously uniform output.

Adequate heating surface is necessary to transmit heat from combustion gases to boiler water. Heating surface is made up of tubes thru which gases travel, and tube sheets.

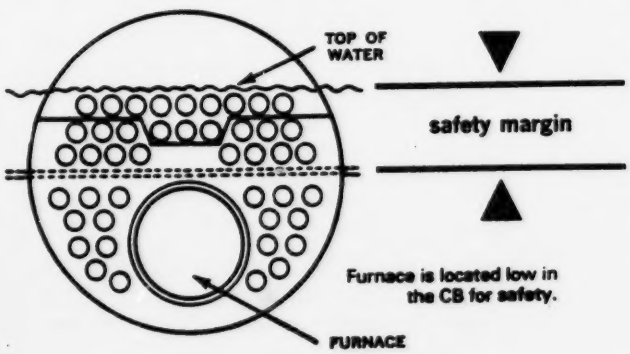
Five square feet of heating surface per boiler horsepower is the greatest amount of heating surface offered in any packaged unit. This results in long life and low maintenance. It's been time-tested to provide adequate heat transfer rates and years of uniformly high output at guaranteed efficiencies.



UPDRAFT CONSTRUCTION

safer operation with low furnace location

Updraft construction means low furnace design. Low furnace location on the CB means safe operation and better combustion. The furnace, containing the hottest combustion gases, lies deep within the water level and is designed with a generous clearance from bottom of the shell to permit full circulation of water, throughout the system. Notice the generous safety margin between furnace and system water level on the CB. There's always a possibility with high furnace design that low water condition could expose the furnace. When furnace is located well below water level, adequate safety margin is assured, foaming action of steam decreases and drier steam is produced.



BURNER DESIGN

...an important factor in high combustion efficiency

The Cleaver-Brooks designed burner is integrally-built into the front head of the CB and swings out when the head is opened for inspection and maintenance. Excellent combustion efficiency is the result of high velocity combustion air thoroughly mixed with fuel to produce high CO_2 with small amounts of excess air, and no CO.

Air Atomizing Oil Burner

One of the most effective burner designs on packaged units is the low pressure, air atomizing burner designed into Cleaver-Brooks CB model. The operational feature of this burner is its ability to produce a high degree of atomization of both light or heavy oils (including No. 6 oil.) Misting of oil provides close contact of oil and air. Oil is burned like gas—cleanly and completely. Complete combustion before the flame reaches the furnace walls makes it possible to control the secondary air to the exact amount for complete combustion.

With heavy oil, the burner nozzle and piping are purged of oil so that heated oil can flow quickly for the next start-up cycle. This eliminates coking of oil in nozzle and congealing of oil in piping. Controls are provided to regulate the oil viscosity and pressure to oil metering valve and to deliver exact amount of fuel to match the load demand.

High Velocity Gas Burner

Complete mixing of air with fuel, plus turbulence are the keys to good gas burner design.

The gas burner on the CB is the high velocity type that offers excellent combustion efficiency. It assures proper air-fuel ratios through a metering device controlled by an adjustable cam and sufficient turbulence to mix air and gas thoroughly.

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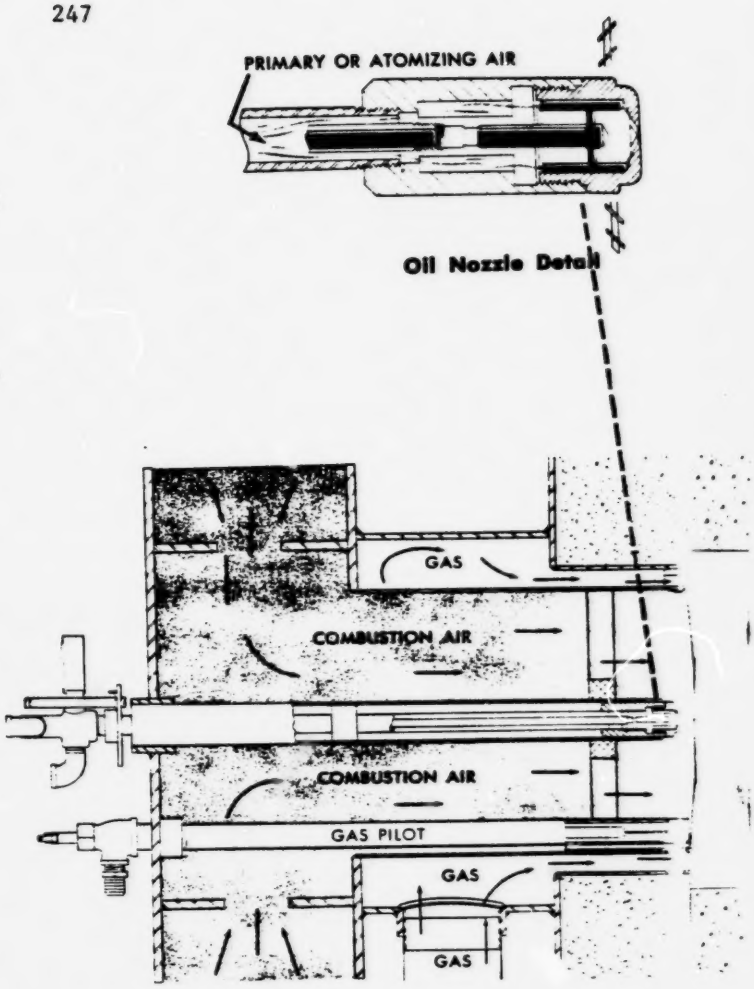
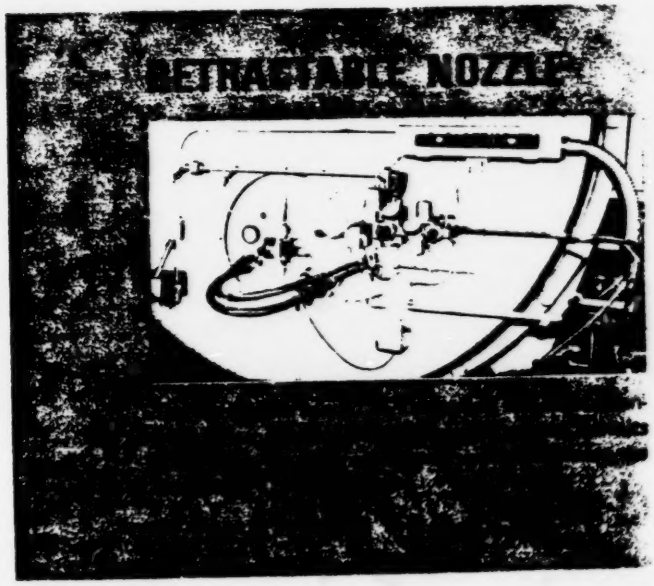


COMBINATION BURNER

...offers quick changeover from one fuel to another

A combination oil or gas fired burner permits user to switch from one fuel to another for economy or in the event of a shortage of fuel. You'll probably select a combination fired unit where gas fuel is not now available but may be in the future. It is well to consider the CB which has an integral gas burner built-in so you can convert quickly to gas firing when gas becomes available.

The combination burner on the CB provides less-than-a-minute changeover from oil to gas or reverse.



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AUTOMATIC OPERATION

...with complete safety

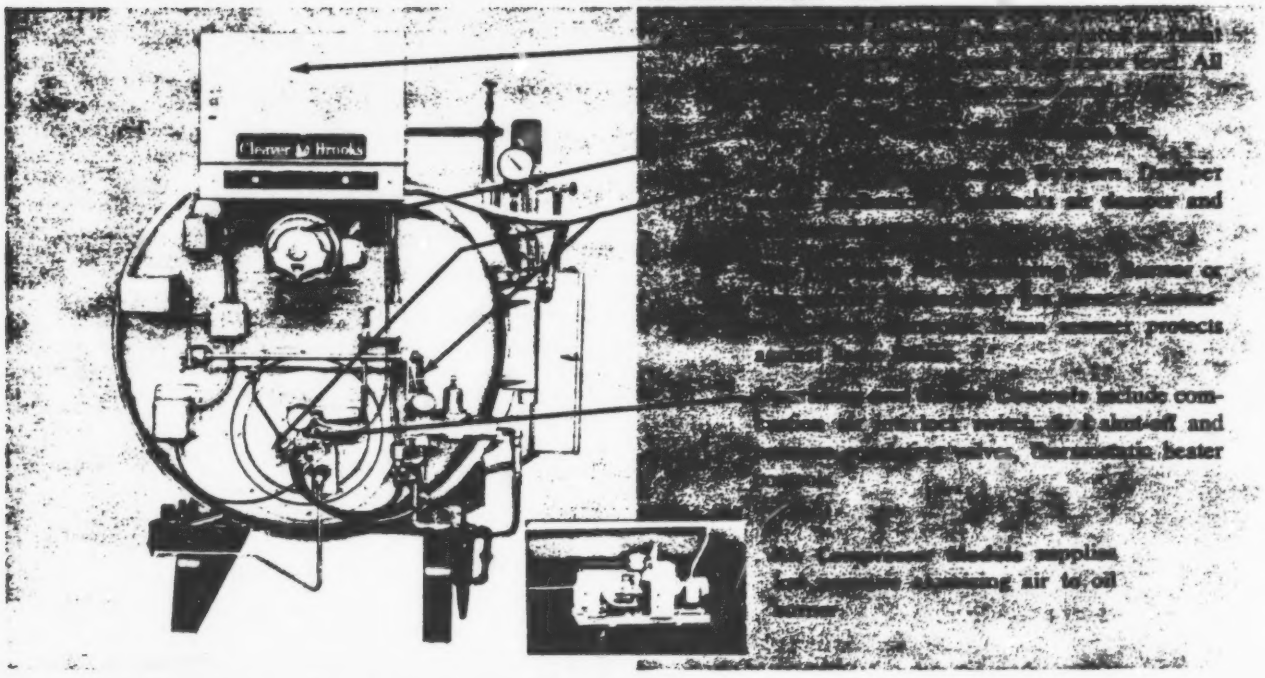
CONTROLS and BURNERS CONVENIENTLY LOCATED ON FRONT HEAD

All CB controls and the burner itself are mounted conveniently on the front head at operator level. All control components are accessible for convenient servicing or inspection.

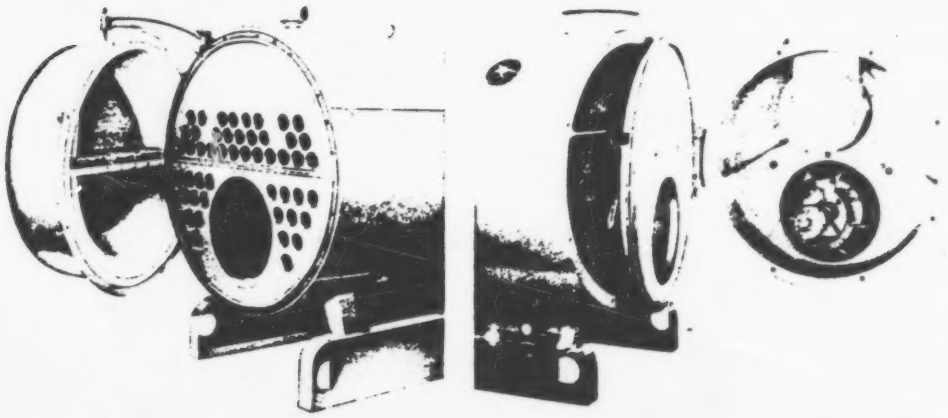
The compact dust proof control panel contains motor starter, control switches and the electronic flame failure control. This electronic watchdog is acutely sensitive to presence or absence of flame, responding only to infra-red radiation of the burner or pilot flame.

CB has full modulation, the ultimate in automatic operation which matches firing to load demand. The CB starts smoothly and quietly and gradually increases the firing rate to full load. 50-800 Hp. units have a 4:1 turndown ratio.

CB boilers are designed and built to comply with the requirements of A.S.M.E., Underwriters' Laboratories, Inc., and Underwriters' Laboratories of Canada. All wiring is coded and exceeds the standards of the National Electrical Code.



CB HINGED AND DAVITED DOORS...*simplify cleaning and maintenance*



CB design takes the trouble out of routine maintenance. Hinged and davited doors, held in place with a few bolts, swing out of the way, exposing tubes for cleaning or fast inspection without necessity of removing any refactory. Rear refactory is wholly contained in rear door. Front and rear doors are sealed with preformed asbestos gaskets.

CB Boilers Provide Sp

1. Fuel Cost Savings and Fuel Conservation:

The boiler with the highest Guaranteed Fuel-to-Steam Efficiency* will burn the least amount of fuel for the same output. You pay your fuel bills based on the Fuel-to-Steam Efficiency of your boiler!

GUARANTEED FUEL-TO-STEAM EFFICIENCIES ON MODEL CB FIRETUBE BOILERS AT 50% AND 100% OF RATING

BOILER SIZE (BHp)	*GAS FUEL				*NO. 2 OIL				*NO. 5 & NO. 6 OILS			
	15# Design 10 PSIG Operation		150# Design 125 PSIG Operation		15# Design 10 PSIG Operation		150# Design 125 PSIG Operation		15# Design 10 PSIG Operation		150# Design 125 PSIG Operation	
	% of Load		% of Load		% of Load		% of Load		% of Load		% of Load	
	50%	100%	50%	100%	50%	100%	50%	100%	50%	100%	50%	100%
100	83.5	83.5	80.5	81.0	86.5%	86.5	83.5	84.0	87.0	87.0	84.0	84.5
125	82.0	82.0	79.0	79.5	85.0	85.5	82.0	83.0	85.5	86.0	82.5	83.5
150	83.0	83.0	80.0	80.5	86.0	86.5	83.0	84.0	86.5	87.0	83.5	84.5
200	83.5	83.5	80.5	81.5	87.0	87.0	84.0	84.5	87.5	87.5	84.5	85.0
250	82.0	82.0	79.5	80.0	85.5	85.5	83.0	83.0	86.0	86.0	83.5	83.5
300	82.5	82.5	80.0	80.5	86.0	86.0	83.5	83.5	86.5	86.5	84.0	84.0
350	83.0	83.0	80.5	81.0	86.5	86.5	84.0	84.5	87.0	87.0	84.5	85.0
400	83.0	83.0	80.0	80.5	86.0	86.5	83.5	84.0	86.5	87.0	84.0	84.5
500	84.0	84.0	81.0	81.5	87.0	87.5	84.0	85.0	87.5	88.0	84.5	85.5
600	84.0	84.5	81.0	82.0	87.5	87.5	84.5	85.5	88.0	88.0	85.0	86.0
700	84.5	84.5	81.5	82.0	87.5	88.0	84.5	85.5	88.0	88.5	85.0	86.0
800	84.5	84.5	81.5	82.0	88.0	88.0	85.0	85.5	88.5	88.5	85.5	86.0

* Fuel Heating Values:
Natural Gas - 1,000 BTU/Cu. Ft.
#2 OIL - 140,000 BTU/Gal.
#5 & 6 Oil - 150,000 BTU/Gal.

Ask your Representative for a copy of . . . "Guaranteed Fuel-to-Steam Efficiency!"

** Fuel-to-Steam Efficiency includes an allowance for Radiation and Convection boiler heat losses from the Unit to the boiler room.*

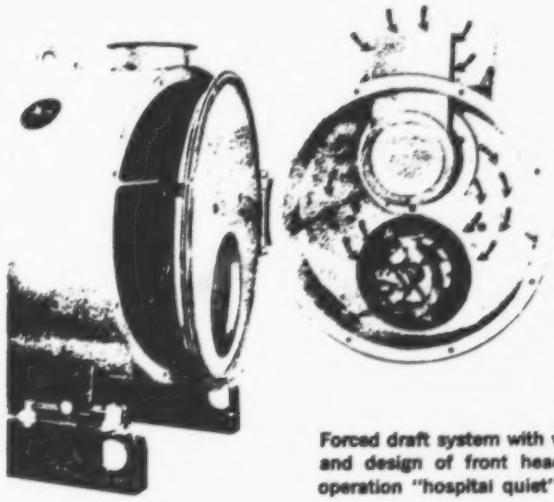
ecial Benefits for YOU!

2. Extremely Low Noise Levels:

UNIQUE CASELESS FAN

keeps operation quiet!

An outstanding feature of the CB is its unusually quiet operation. Fan noise is often a problem with mechanical equipment — not so with Cleaver-Brooks. The exclusive CB caseless fan design draws combustion air into the large plenum chamber of the front head, which confines and deadens fan and air noises. At peak loads, the CB more than meets the low sound levels required for schools, hospitals and institutions. Air inlet is accoustically lined.



Forced draft system with vibrationless impeller and design of front head keeps CB operation "hospital quiet"

SOUND PRESSURE LEVEL SUMMARY

FIRETUBE BOILERS 48" THRU 96" DIA.

Sound Pressure levels measured on boilers operating in various locations and expressed in dBA are as follows:

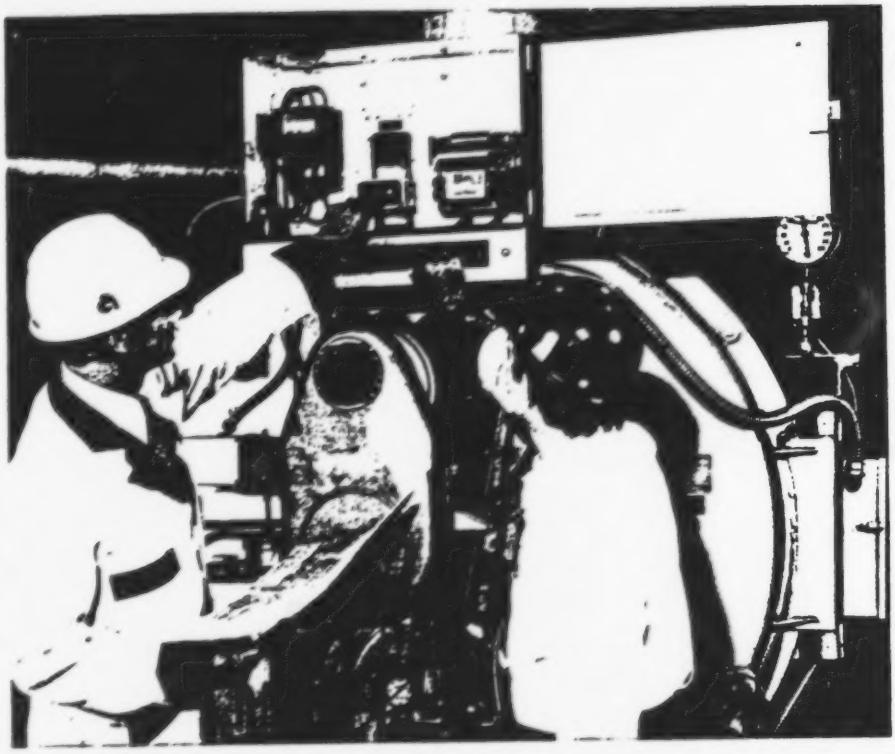
Boiler	CB-50	CB-60	CB-70	CB-80	CB-100	CB-125A	CB-125	CB-150	CB-200
HFO, dBA	79	79	79	79	81	82	83	83	83
LFO, dBA	78	78	78	78	79	79	81	82	81
HFG, dBA	77	77	78	78	78	79	81	80	82
LFG, dBA	72	73	74	75	75	76	78	77	78

Boiler	CB-250	CB-300	CB-350	CB-400	CB-500	CB-600	CB-700	CB-800
HFO, dBA	88	88	89	83	83	83	85	88
LFO, dBA	86	86	86	80	82	82	82	84
HFG, dBA	84	86	86	82	82	82	86	87
LFG, dBA	81	82	83	80	81	81	82	84

ABBREVIATIONS: HF = High Fire LF = Low Fire O = Oil G = Gas

TEST METHOD: The sound pressure levels tabulated above were obtained from tests run in accordance with the "ABMA Test Code for the Measurement of Sound from Packaged Boilers." In accordance with this Code the sound pressure levels reported above were measured on the boiler centerline 4½ feet vertically above the bottom of the base rails and 3 feet horizontally in front of the end of the blower motor or front surface of the electrical cabinet.

STARTING SERVICE



Cleaver-Brooks offers the industry's finest parts facilities and factory starting service coast to coast and in Canada

Complete starting service that assures you of trouble-free performance in the field is included with the purchase of every boiler. A factory-trained specialist starts up the unit, re-adjusts controls to suit the particular fuel you are using, checks over details of operation, takes CO_2 readings under your load and trains your operator in care and maintenance. He covers 32 items on his check list and personally makes sure the boilers are adjusted for peak efficiency.

This service, full evidence of Cleaver-Brooks complete follow up responsibility, is available to every owner of CB boilers anywhere in the United States and Canada.

CB DIMENSIONS and RATINGS

Dimensions and Ratings on CB 15 thru 40 HP Upon Request

NOTE: Dimensions must be confirmed for construction.

	Horsepower
LENGTHS	Overall Shell Base Frame Front Head Extension Rear Head Extension
WIDTHS	Overall I. D. Boiler Center to Water Column Center to Lagging Base, Outside
HEIGHTS	Overall Base to Vent Outlet Base to Steam Outlet Height of Base
BOILER CONNECTIONS Connections threaded unless indicated – fig. 150# Mfg. 300# ASA	Feedwater, Right and Left **Low Pressure (15 lb and** Steam Nozzle Drain, Front and Rear **High Pressure (150 lb o** Surface Blowoff, Top Steam Nozzle Blowdown, Front and Rear
VENT STACK	Diameter (flgd. connection) Front Ring Flange to Vent
MIN. CLEARANCES	Rear Door Swing Front Door Swing Tube Removal, Rear Tube Removal, Front
MINIMUM BOILER ROOM LENGTH ALLOWING FOR DOOR SWING AND TUBE REMOVAL FROM:	Rear of Boiler Front of Boiler Thru Window or Doorway
RATINGS **sea level** **to 3000 ft**	Rated Capacity Lbs steam hr 212 F BTU Output 1000 BTU hr EDR steam gross, sq. ft
APPROXIMATE FUEL CONSUMPTION	Light Oil GPH Heavy Oil GPH
	Gas CFH 500 BTU-mfg 800 BTU-mixed 1000 BTU-natural Gas (therms per hr
POWER REQUIREMENTS	Blower Motor HP All Models Except Gas Gas Models Only
	Oil Pump Motor, HP No. 2 Oil No. 4 Oil No. 5 & No. 6 Oil
	Oil Heater KW No. 4 Oil No. 5 & No. 6 Oil
	Air Compressor Motor HP, Oil Firing Only

† No. 6 Oil

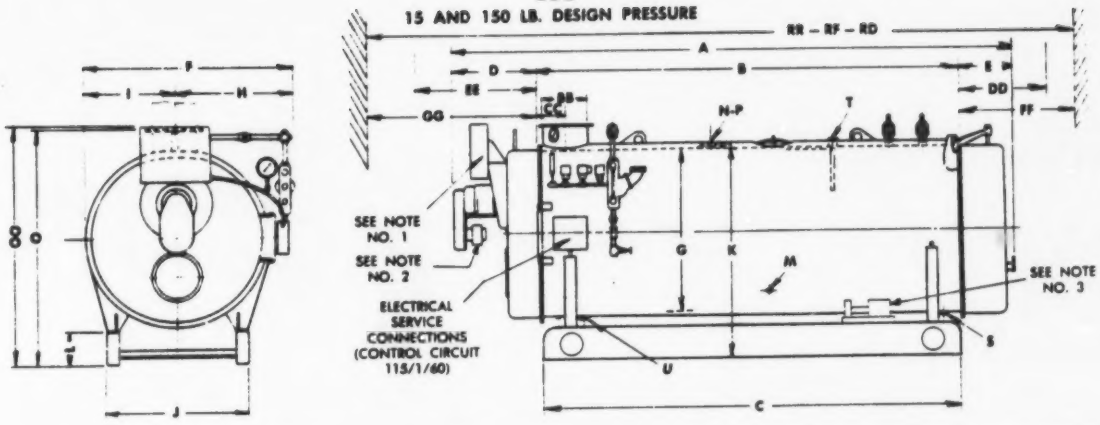
‡ No. 5 Oil

* 10KW on Low Pressure

Note 1: Control panel relocated on boilers 250 hp and up

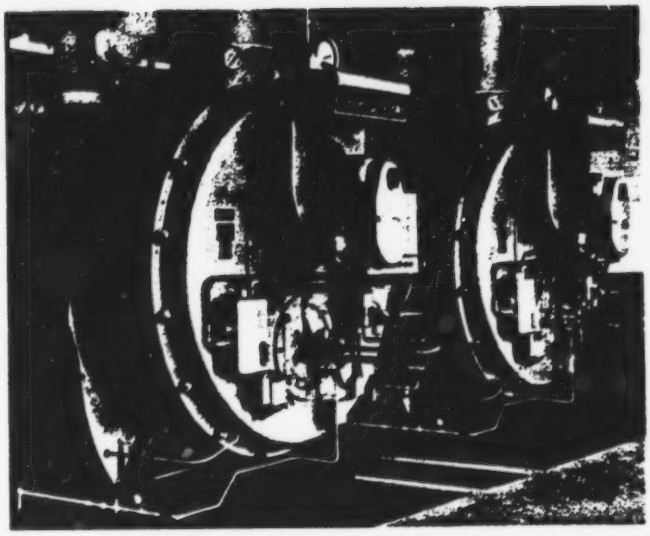
Note 2: Air compressor belt driven from blower motor on sizes

Note 3: Air compressor module on sizes 50 through 100 HP and (Units Manufactured in Canada 50 through 100 HP size compressor. Refer to Form CS-3314 for power requirem

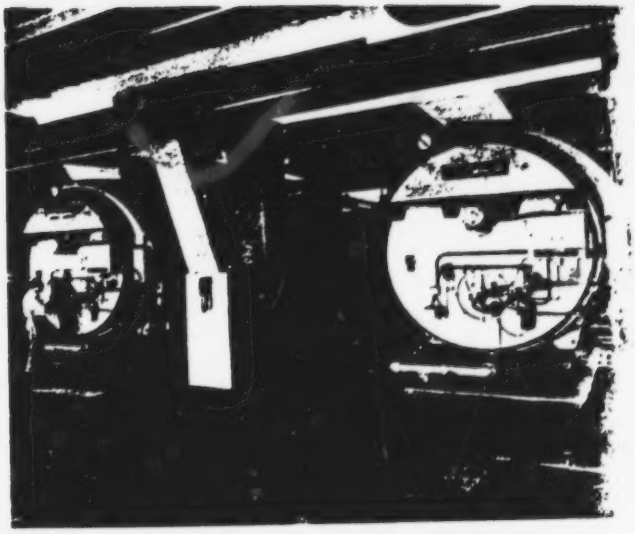


Dim.	50	60	70	80	100	125	150	200	250	300	350	400	500	600	700
A	10'-11"	10'-11"	14'-3"	14'-3"	15'-10"	14'-7"	16'-7"	19'-7"	16'-9"	19'-2"	21'10"	16'-11"	19'-11"	23'-2"	25'-11"
B	7'-8"	7'-8"	10'-11"	10'-11"	12'-6"	10'-5"	12'-5"	15'-0"	12'-0"	14'-3"	16'-9"	12'-8"	15'-6"	18'-6"	21'-3"
C	7'-7"	7'-7"	10'-10"	10'-10"	12'-4"	10'-4"	12'-4"	14'-11"	11'-11"	14'-2"	16'-8"	12'-7"	15'-5"	18'-5"	21'-2"
D	21"	21"	22"	22"	22"	31"	31"	36"	34"	36"	38"	24"	25"	29"	29"
E	18"	18"	18"	18"	18"	19"	19"	19"	23"	23	23"	27"	27"	27"	27"
F	63"	63"	63"	63"	63"	76"	76"	76"	98"	98"	98"	116"	116"	116"	116"
G	48"	48"	48"	48"	48"	60"	60"	60"	78"	78"	78"	96"	96"	96"	96"
H	36"	36"	36"	36"	36"	43"	43"	43"	56"	56"	56"	65"	65	65"	65"
I	27"	27"	27"	27"	27"	33"	33"	33"	42"	42"	42"	51"	51"	51"	51"
J	36"	36"	36"	36	36"	51"	51"	51"	64"	64"	64"	72"	72"	72"	72"
OO	6'-5"	6'-5"	6'-5"	6'-5"	6'-5"	7'-2"	7'-2"	7'-2"	8'-10"	8'-10"	8'-10"	10'-8"	10'-8"	10'-8"	10'-8"
O	5'-10"	5'-10"	5'-10"	5'-10"	5'-10"	7'-1"	7'-1"	7'-1"	8'-10"	8'-10"	8'-10"	10'-8"	10'-8"	10'-8"	10'-8"
K	5'-6"	5'-6"	5'-6"	5'-6"	5'-6"	6'-5"	6'-5"	6'-5"	8'-0"	8'-0"	8'-0"	9'-10"	9'-10"	9'-10"	9'-10"
L	12"	12"	12"	12"	12"	12"	12"	12"	11"	11"	11"	18"	18"	18"	18"
M	1¼"	1¼"	1¼"	1¼"	1¼"	1½"	1½"	2"	2"	2"	2½"	2½"	2½"	2½"	2½"
N	6" Fl	6" Fl	6" Fl	6" Fl	8" Fl	8" Fl	8" Fl	10" Fl	10" Fl	12" Fl	12" Fl	12" Fl	12" Fl	12" Fl	12" Fl
S	1¼"	1¼"	1½"	1½"	1½"	1½"	1½"	1½"	2"	2"	2"	2"	2"	2"	2"
T	—	—	—	—	—	1"	1"	1"	1"	1"	1"	1"	1"	1"	1"
P	3"	3"	3"	3"	4" Fl §	4" Fl §	4" Fl §	4" Fl §	6" Fl §	6" Fl §	6" Fl §	6" Fl §	8" Fl §	8" Fl §	8" Fl §
U	1¼"	1¼"	1½"	1½"	1½"	1½"	1½"	1½"	1½"	1½"	1½"	2"	2"	2"	2"
BB	10"	10"	12"	12"	12"	16"	16"	16"	20"	20"	20"	24"	24"	24"	24"
CC	6"	6"	7"	7"	7"	9"	9"	9"	11"	11"	11"	15"	13"	13"	13"
DD	4'-7"	4'-7"	4'-7"	4'-7"	4'-7"	2'-8"	2'-8"	2'-8"	3'-7"	3'-7"	3'-7"	4'-5"	4'-5"	4'-5"	4'-5"
EE	4'-7"	4'-7"	4'-7"	4'-7"	4'-7"	5'-7"	5'-7"	5'-7"	7'-5"	7'-5"	7'-5"	9'-0"	9'-0"	9'-0"	9'-0"
FF	7'-0"	7'-0"	10'-3"	10'-3"	11'-10"	9'-7"	11'-7"	14'-2"	10'-11"	13'-1"	15'-7"	11'-3"	14'-1"	17'-1"	17'-1"
GG	6'-2"	6'-2"	9'-5"	9'-5"	11'-0"	8'-7"	10'-7"	13'-2"	9'-8"	11'-10"	14'-4"	9'-9"	12'-7"	15'-7"	15'-7"
RR	19'-3"	19'-3"	25'-9"	25'-9"	28'-11"	25'-7"	29'-7"	34'-9"	30'-4"	34'-9"	39'-9"	32'-11"	38'-7"	44'-7"	50'-1"
RF	18'-5"	18'-5"	24'-11"	24'-11"	28'-1"	21'-8"	25'-8"	30'-10"	25'-3"	29'-8"	34'-8"	26'-10"	32'-6"	38'-6"	44'-0"
RD	16'-10"	16'-10"	20'-1"	20'-1"	21'-8"	18'-8"	20'-8"	23'-3"	22'-11"	25'-2"	27'-8"	26'-1"	28'-11"	31'-11"	34'-8"
	1.725	2.070	2.415	2.760	3.450	4.313	5.175	6.900	8.625	10.350	12.075	13.800	17.250	20.700	24.150
	1.674 6.970	2.009 8.370	2.343 9.760	2.678 11.160	3.348 13.950	4.184 17.450	5.021 20.920	6.695 27.900	8.369 34.900	10.043 41.850	11.716 48.820	13.390 55.800	16.738 69.750	20.085 83.700	23.430 97.650
	15.0 14.0	18.0 16.5	21.0 19.5	24.0 22.5	30.0 28.0	37.5 35.0	45.0 42.0	60.0 56.0	74.5 69.5	89.5 83.5	104.5 97.5	119.5 111.5	149.5 139.5	179.5 167.5	209.0 195.5
	4.190 2.615 2.095 21.0	5.020 3.140 2.510 25.1	5.860 3.665 2.930 29.3	6.700 4.190 3.350 33.5	8.370 5.235 4.185 41.9	10.460 6.540 5.230 52.3	12.560 7.850 6.280 62.8	16.740 10.460 8.370 83.7	20.920 13.080 10.460 104.6	25.110 15.695 12.555 125.5	29.300 18.315 14.650 146.5	33.500 20.940 16.750 167.5	41.850 26.155 20.925 209.3	50.200 31.375 25.100 251.0	58.500 36.610 29.300 293.0
	2	2	2	2	3	5 5	7½ 5	10 10	7½ 7½	10 7½	15 15	10	15	20	30
	⅓ ⅓ ⅓	⅓ ⅓ ½	⅓ ⅓ ⅓	⅓ ⅓ ⅓	⅓ ⅓ ⅓	⅓ ⅓ ½	⅓ ⅓ ½	⅓ ⅓ ½	⅓ — ½	¾ — ½	¾ — 1	¾ — 1	¾ — 1	¾ — 1	1½ — 1
	2 5	2 5	2 5	2 5	3 5	3 5	3 5	3 +5 ±7.5	— 7.5	— 7.5	— 7.5	— 7.5	— 7.5*	— 7.5*	— 7.5*
	2	2	2	2	2	← Air Compressor Belt-Driven From Blower Motor →						5	5	5	5

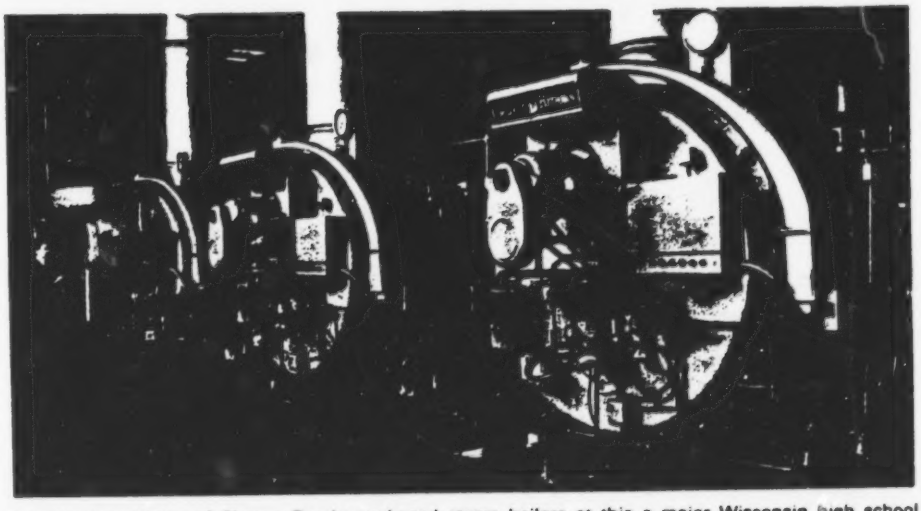
Note: 800 Hp Boiler Dimensions and Ratings Available on Request.



Lebanon Steel Foundry — Two 250 horsepower heavy oil fired Cleaver-Brooks boilers are the work horses for this modern foundry. Located at Lebanon, Pennsylvania, the manufacturing center for Cleaver-Brooks, appropriately called the "Boiler Capital of the World."



Nashville, Tennessee — Two 500 horsepower light oil and natural gas Cleaver-Brooks steam boilers are the main power source providing he and cooling comfort to this mid-southern office complex.



A typical installation of Cleaver-Brooks packaged steam boilers at this a major Wisconsin high school. These boilers, each rated at 350 hp. provide comfort heating for the school. Such installations also are capable of providing air conditioning where needed.

Cleaver Brooks

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h) Cottage Hospital

Description

The Cottage Hospital in Edzo is operated by Health and Welfare Canada, and serves the Rae Edzo and surrounding small communities of Rae Lakes, Lac La Martre, etc. The building is a flat roof wood frame structure with an enclosed area of approximately 2400 ft.^{2} on each of two levels. The main floor is used for patient care, laboratories and support services. Some administrative office space, mechanical room, and storage space are located on the lower floor. The building has totally independent electricity and water supply facilities as back-up stand-by to municipal services. The hospital was built in 1974, appears to be structurally sound, well maintained, and infiltration tight.

Heating System

The heating system consists of two hot water boilers and a water distribution loop. The small boilers are located on the lower floor (below grade) in a room with walls exposed to the outdoors. Each boiler is a Weil-McLean model B-473 oil fired hot water boiler with a rated output capacity of 259,000 BTU/hr. at 15 psig. One boiler is able to carry the heating load

for outside temperatures warmer than -30°C. The boilers are operated by the janitor and serviced as required by the federal medical services office in Yellowknife. The boilers appear to be in good condition.

Requirements to Convert to Wood Heating

A wood fired hot water boiler with an automated fuel stoker would be most suitable for this application. The boiler could be placed in the existing mechanical room. However, initial installation may require opening a hole in the foundation wall, or destroying interior door frames and partitions. An automatic stoker would be demanded by the hospital since maintenance staff are on 40 hr/wk duty and evening staff levels are minimal, consistent with patient care requirements.

i) Roman Catholic Church and Mission

Description

The Roman Catholic parish in Rae occupies three buildings: the church, the mission office and residence, and the Grey Nun's residence house. The Grey Nun's residence is a relatively energy efficient 1000 - 1200 ft.^{2} single storey house heated primarily with an air tight stove and wood fuel. An oil furnace serves as back-up.

The church is a large wood frame building of approximate plan dimensions 80' x 35'. The church has a large enclosed volume by virtue of a high ceiling and vault. The building was erected in 1925 and has had modest repairs and insulation upgrading over the years. The church is used basically one day per week and the rest of the time maintained at a low temperature.

The mission office and residence is a two storey wood frame structure with approximately 1900 ft.^{2} on each level. The building was erected in 1958. Double pane wood casing windows are installed and porches are built in each exterior entry way. The building is kept at 64°F (18°C) in the winter to conserve heat energy.

Heating Systems

The church is heated with an oil fired furnace. No size information was available. The mission is heated using an Anthes Imperial oil fired hot air furnace. The furnace has a rated output capacity of 172,000 BTU/hr. The furnace is located in the unfinished basement of the mission. The basement floor is rock outcropping and natural gravel. The concrete foundation walls are uninsulated. Furnace hot air is circulated up into the living space by insulated ducting. The furnace chimney passes through the interior of the building. The heating system appears reasonably well maintained and could be expected to last another 10+ years.

Requirements to Convert to Wood Heating

The church is not a good candidate for wood conversion due to its low occupancy and normal low building temperature.

The mission may best benefit from the installation of an airtight wood stove on each level. A number of young people in the service of the church could be called upon to haul wood to the fire side. The occupancy in the mission is generally low but at least one person is usually around to receive visitors and could tend a stove. A wood fired hot air furnace could also be considered provided it is small enough to be brought in through the stairwell and is a low profile unit. The mission basement has a 4.5' - 6' irregular floor - to ceiling height. A hole in the concrete foundation would be most practical to bring wood fuel to the furnace. An automated wood fuel stoker would be desirable but possibly not affordable on the frugal church budget.

j) Future Old Folks Home

Description

An Old Folks home is being planned for the Rae community, opposite the Nishi Khon Centre. Recent concepts call for 14 living units for independent residents, eight limited personal care units, and space for common facilities such as lounge/recreation room, laundry, etc. The tentative space programming is indicated in Table A4.3/1. Project approval or time of construction is not determined. The building is planned for location in a former school yard south of the Nishi Khon Centre.

Heating System

No heating system details have been established. Probably a central hot water based system will be favored. Individual wood fuel cook stoves or airtight stoves may be favoured by some of the residents, in keeping with their lifestyle. All things considered, however, the wood fuel alternative most likely to win approval by N.W.T. Housing Corporation, C.M.H.C., the GNWT Department of Health, and local community leaders would be a centralized wood boiler unit operated under the supervision of the resident caretaker. A boiler system with an output capacity of 750,000 - 1,000,000 BTU/hr. may be required to support this facility. The annual fuel oil consumption may be in the order of 25,000 litres.

Table A4.3/1 RAE EDZO OLD FOLKS HOME

SPACE REQUIREMENT

a. Supervisory Care 45.0 m^2 x 14 units			630 m^2
i)	sleeping area	11.0	
ii)	bathroom	3.3	
iii)	living/dining area	23.5	
iv)	kitchen	4.0	
v)	storage (clothes closet, linen, seasonal and other)	4.7	
vi)	entrance	2.0	
		45.0 m^2	
b. Limited Personal Care			
Personal Facilities 22.0 m^2 x 8 units			176 m^2
i)	sleeping area	4.2	
ii)	washrooms	3.3	
iii)	living/dining area	13.5	
iv)	storage	1.0	
		22.0 m^2	
c. Support Facilities			56.8 m^2
i)	bathroom/shower	7.0	
ii)	private lounge (2 @ 13.5 m^2 each)	27.0	
iii)	kitchen	13.5	
iv)	food storage (pantry and freezer)	9.3	
		56.8 m^2	
d. Common Facilities			225.7 m^2
i)	lounge/recreation room 45 persons @ .75 m^2/person 28 persons @ 1.2 m^2/person	33.8	
	lounge storage	15.0	
ii)	public washrooms (2 @ 2.3 m^2 each)	4.6	
iii)	administration office	6.5	
iv)	laundry	15.0	
v)	building repair & storage	11.0	
vi)	mechanical & electrical room	50.0	
vii)	caretaker's suite (CMHC 2 bedroom)	75.0	
viii)	janitor	2.8	
ix)	exterior facilities	12.0	
		225.7 m^2	
	TOTAL (net)	1088.5 m^2	
	Total circulation, wall allowance 20%	217.7 m^2	
	TOTAL SPACE REQUIREMENT	1306.2 m^2 => 14,053 $ft.^2$	

Area per resident is 59.4 m^2

k) Future Rae Recreation Centre

Description

A $2.5 million recreation complex commenced construction in April, 1984 in the north end of the Rae community. The complex features a full size natural ice arena, full size gymnasium, two sheets of natural ice curling rink, lounge, change rooms, concessions and related commercial space. The complex has a gross floor area of approximately 39,000 ft.^{2}. The ice surface areas are partially heated to improve and stabilize ice conditions.

The programmed area for the complex is as follows:

Curling area	572 m^2
Arena	1829 m^2
Gymnasium	405 m^2
Main Floor Core - Lounge, entry, change rooms, wash rooms, etc.	589 m^2
Mezzanine	263 m^2
	3658 m^2

Heating System

The heating system is a conventional oil fired hot water boiler system. Preliminary projections suggest a fuel oil consumption of 50,000 litres per year. The figure is quite dependent on facility utilization, as fresh make up air brought in by air handling units represent a significant heat load. The system consists of two hot water boilers, with hot water distribution loops to heat the central core of the building. Ceiling mount radiators of novel design are employed to transfer heat in the various rooms. Electric radiator panels in the ice arenas are used to partially heat these portions of the facility.

Requirements to Convert to Wood Heating

The planning work in support of the Rae recreation centre (ref. 10) identified the economic advantages and viability of a wood fuelled heating

system. Due to constraints in capital financing, the notion of wood heating was dropped in favour of a conventional oil fired heating system. The requirements to retrofit a wood fired system includes the creation of a building addition to house new equipment, the installation of a wood fired boiler, stoker system, and chimney; and the tie-in of the wood boiler hot water supply and cold return to the existing plumbing.

1) Future Rae Primary School

Description

A kindergarten to grade 3 primary school for Rae is identified in the 1986 capital budget plan for the Department of Education. No details regarding space programming or structure are presently available. The school may have 6 - 7 classrooms plus some special purpose rooms and administrative space. The building site is adjacent to the new Rae recreation centre - to take advantage of the facilities there. For the purposes of this project the school is assumed to be on the order of 15,000 $ft.^2$ with an annual fuel oil consumption of perhaps 65,000 litres.

A. 4.4 RESIDENTIAL HOUSING

The housing stock in Rae Edzo is estimated to be 235 homes, as follows:

a)	private homes	est. 85
b)	Northern rentals	107
c)	new public housing	
	2 bedroom units	10
	3 bedroom units	15
	4 bedroom units	18
		235

The NWTHC properties list include some units rented to the GNWT as staff housing units.

a) Private Homes

Most of the private homes in the community are located on Bay Island in Rae. The homes tend to be smaller, not energy efficient, and use wood as a primary heat source. Descriptions of some private homes visited are given below. The owners names are not mentioned in the interests of privacy.

House A

This dwelling is a 1½ storey wood frame house with a main floor area of approximately 300 ft.^{2}. A 120 ft.^{2} kitchen space has more recently been constructed. The home is reported to have R12 insulation in the roof and walls. Single pane wood frame windows are sealed with polyethylene in winter to reduce air infiltration. An older model airtight updraft wood stove is used for space heating in the kitchen area. A non baffled radiant heater (oil fired) is used to heat the main portion of the house. The unit is a 49,200 BTU/hr rated Enterprise Foundary updraft heater. Heat is released to the surrounding room by natural convection. Cut outs in the ceiling help to circulate warm air up to an upstairs sleeping area. Without wood fuel heating, the house reportedly would consume approximately 750 litres of fuel oil per month. Oil is still the major heat source in

this home. The home could benefit from increased insulation and other conservation measures. An efficient airtight wood stove or a wood/oil combination unit could be installed in place of the Enterprise heater. No space exists to add another heating appliance.

House B

This frugal two room house has plywood exterior and wood frame construction. Entrance to the living area is through an exterior porch or shed. The level of insulation was not known. The 20' x 20' house was heated by means of a 4 - 5 cu. ft. barrel shaped wood burning stove. The annual wood fuel consumption was reported to be 15 cords. A new efficient air tight wood stove is suggested for this home.

House C

This home is a reasonably new log house with a conventional truss roof. Double pane wood framed windows were installed. R-20 walls and R-30 ceiling insulation was used. The primary source of heat is a new wood stove. The winter of 1983 - 84 is the first heating season for the new 900 - 1000 ft.^{2} home. No fuel consumption data was available.

House D

The home is a modern mobile home or trailer unit 14' x 72'. The home is heated by propane. The home is owned by a local entrepreneur. No fuel consumption data was available. The owner does not use wood heating and is prepared to pay higher fuel bills for the convenience.

House E

This home is a 1000 ft.^{2} wood frame structure partitioned into kitchen, living room and three bedrooms. The home is heated with wood using two stoves. One stove is located in the kitchen and is used for cooking purposes. A second stove is located in the centre of the 18' x 30' living

area. The annual wood fuel consumption was reported to be 32 cords. The home was in fair condition generally but could benefit from energy conservation upgrading. A more efficient stove for the living room is suggested.

b) Northern Rentals

The floor plans for two "northern rental" version public housing dwellings are sketched in Figure 4.4/1. Most of these homes are of similar construction. Floor plans vary slightly within the rectangular enclosure depending on total size (number of bedrooms).

House A

This house was examined while it was in the process of extensive renovations. The 24' x 32' house was 2" x 4" wood frame construction. Perimeter walls were fitted with R-12 fibreglass insulation. Vapour barrier, ceiling insulation thicknesses etc. were not discernable.

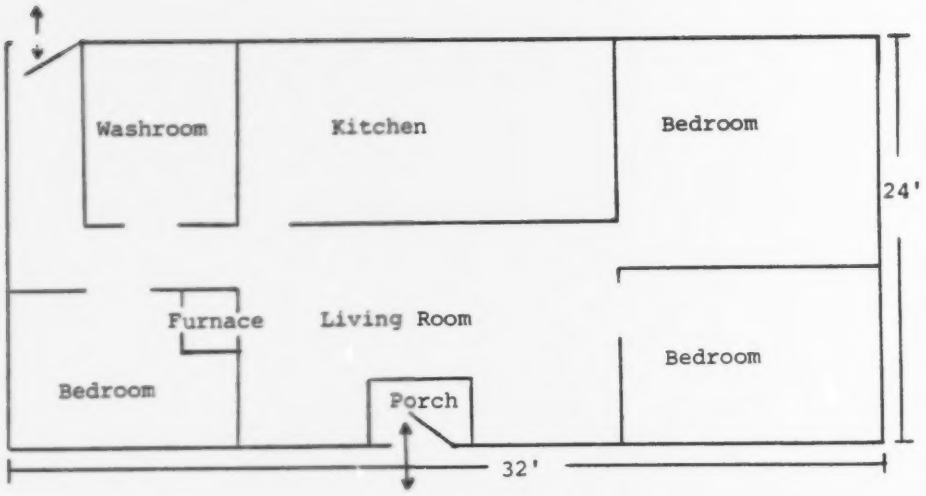
The 1972 built home was equipped with a Moffat, 91,000 BTU/hr. oil fired hot air furnace. Refurbishing activities consist of replacement of plumbing and electrical as required; replace wall insulation to original standard; replace interior wall panels and surfaces, and exterior surfaces. The furnace is located in a room in the central portion of the house. The space could not be used to substitute a wood stove. A wood fuelled furnace is not suggested for the space due to the small space and since wood and ashes must be carried through the house to or from the furnace location. The most reasonable approach may be to install an airtight wood stove in the living room area to supplement the oil furnace.

House B

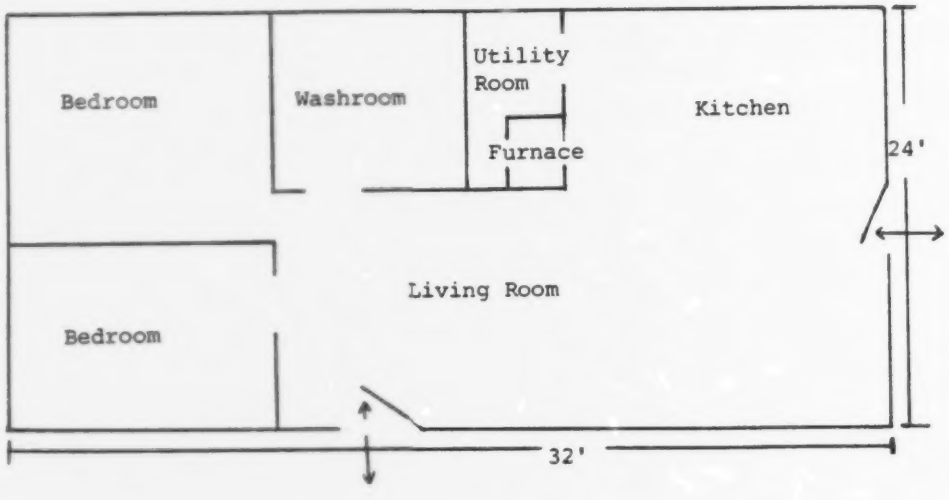
This house is a bungalow style single storey wood frame home. The floor elevation of the home is 3 ft. above grade. The exterior is finished with vertical tongue and groove wood siding. The interior walls are wood

Figure 4.4/1 HOUSING FLOOR PLANS

a)



b)



panelled. The heating system consists of an Olsen, Inc. 94,000 BTU/hr. oil fired hot air furnace. The furnace is located in the central portion of the enclosure. As discussed for house A, the most reasonable approach to wood conversion here may be to install an airtight wood stove in the living area, adjacent to an exterior wall and the entry way.

c) New Public Housing

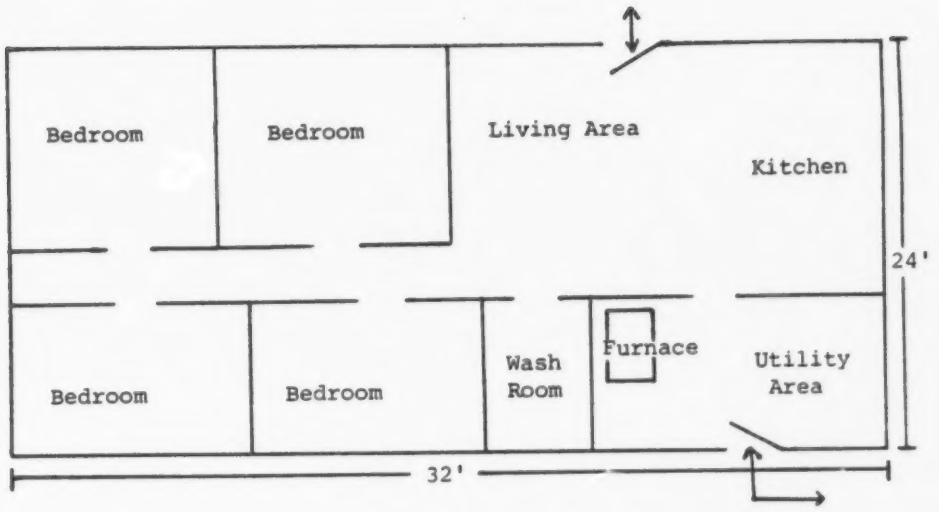
Newer style public housing units exist in the community in perhaps four or five basic floor plans and construction types. Some typical floor plans are illustrated in Figure 4.4/2.

House A

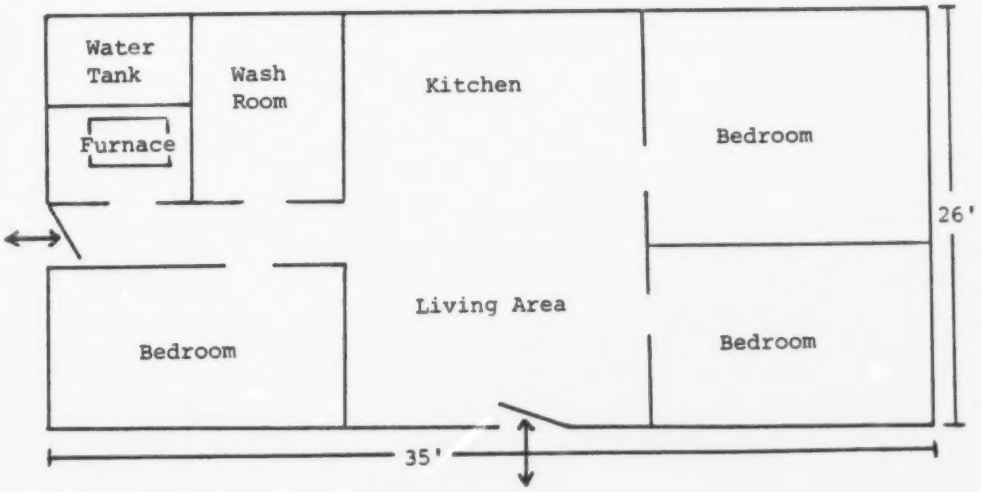
This home is typical of the four bedroom housing units built in recent years. The house is a single storey wood frame structure built on a foundation to raise the floor 3 ft. above grade. The building exterior is finished with metal siding. The interior of the 2" x 4" frame walls are finished with wood panelling. R-12 insulation is applied in the walls and ceiling. The complete 24' x 32' enclosure is heated with an Enterprise 139,000 BTU/hr oil fired hot air furnace. A simple ductwork system is installed to distribute heat to the bedroom area. The furnace is located at an accessable spot in the utility area near an entrance way.

A number of alternatives to convert or supplement the oil fired heating system are possible. The existing furnace can be replaced with a wood fired furnace or a wood/oil conbination unit. Fuel can be brought in through the entrance way, or conveniently through a small access door in the adjacent exterior wall. Alternately, space exists in the living room to install an airtight wood stove to provide supplementary heat to the oil furnace.

Figure 4.4/2 HOUSING FLOOR PLANS



Four Bedroom



Three Bedroom

House B

This home is based on 1983 - 84 construction specifications and represents the most energy efficient designs in the community. The 1½ storey wood frame structure features 2" x 6" exterior walls with R-20 insulation, R-40 insulated ceiling, six mil internal vapour barrier, and Tyvek external infiltration barrier. The exterior is finished in wood siding; the roof exterior is sheet steel panels. The main floor plan dimensions are approximately 24' x 24'.

The house is heated by means of a Coleman Model 871, 80,000 BTU/hr oil fired hot air furnace. The installation of an air tight wood stove in the living room is suggested as a suitable means to introduce wood fuel heating into this house.

House C

This house is a two bedroom bungalow style home approximately 8 years old. The wood frame structure has metal exterior siding, 2" x 4" walls with R-12 insulation and interior panelling. Double pane wood framed windows were installed. The home is built on a piling foundation with the main floor level 3 - 4 ft. above the sand and gravel grade. As typical in many of the homes nearby, the foundations have shifted resulting in gaps between the floor and partition walls. The doors and windows seasonally realign themselves in their frames and are perpetually out of adjustment. The home is heated with an Enterprise 139,000 BTU/hr. oil fired hot air furnace located near an entrance way, with access to an outside wall.

The house could be converted to wood by the installation of a wood furnace or a wood/oil combination unit.

House D

This home is one of the buildings refurbished as part of the 1981 - 82 housing rehabilitation program. The home is in like new condition and

very well kept. The single storey three bedroom house is fitted with exterior wood siding, 2" x 4" walls, R-12 wall insulation and inside panelling. Floors are carpeted or lino covered. The home is built on a piling foundation with the main floor raised 3 ft. above grade.

Space heating is provided by an Olsen, Inc. HTL 115, 115,000 BTU/hr. oil fired hot air furnace on the main floor at one end of the house. Under floor ductwork carries heat to the various rooms of the house. Since the living room is small, the most appropriate wood conversion would be to substitute a wood/oil combination furnace. A porch would be required on the outside of the home if a large volume of extra space is required.

Appendix 5.0

COMMUNITY FUEL WOOD SUPPLY

Excerpted from:

MOSQUITO CREEK FUELWOOD ALLOCATION

and

HARVEST PLAN

for

RAE and YELLOWKNIFE PERMITTEES

Timber Management Section
Indian and Northern Affairs Canada

July 25/83

BACKGROUND

To help meet the present and proposed escalation of fuelwood needs by the Rae-Edzo and Yellowknife people, an assessment of the fire-killed fuelwood reserves in the Mosquito Creek Area was undertaken during June, 1983 by the D.I.A.N.D. Timber Management staff.

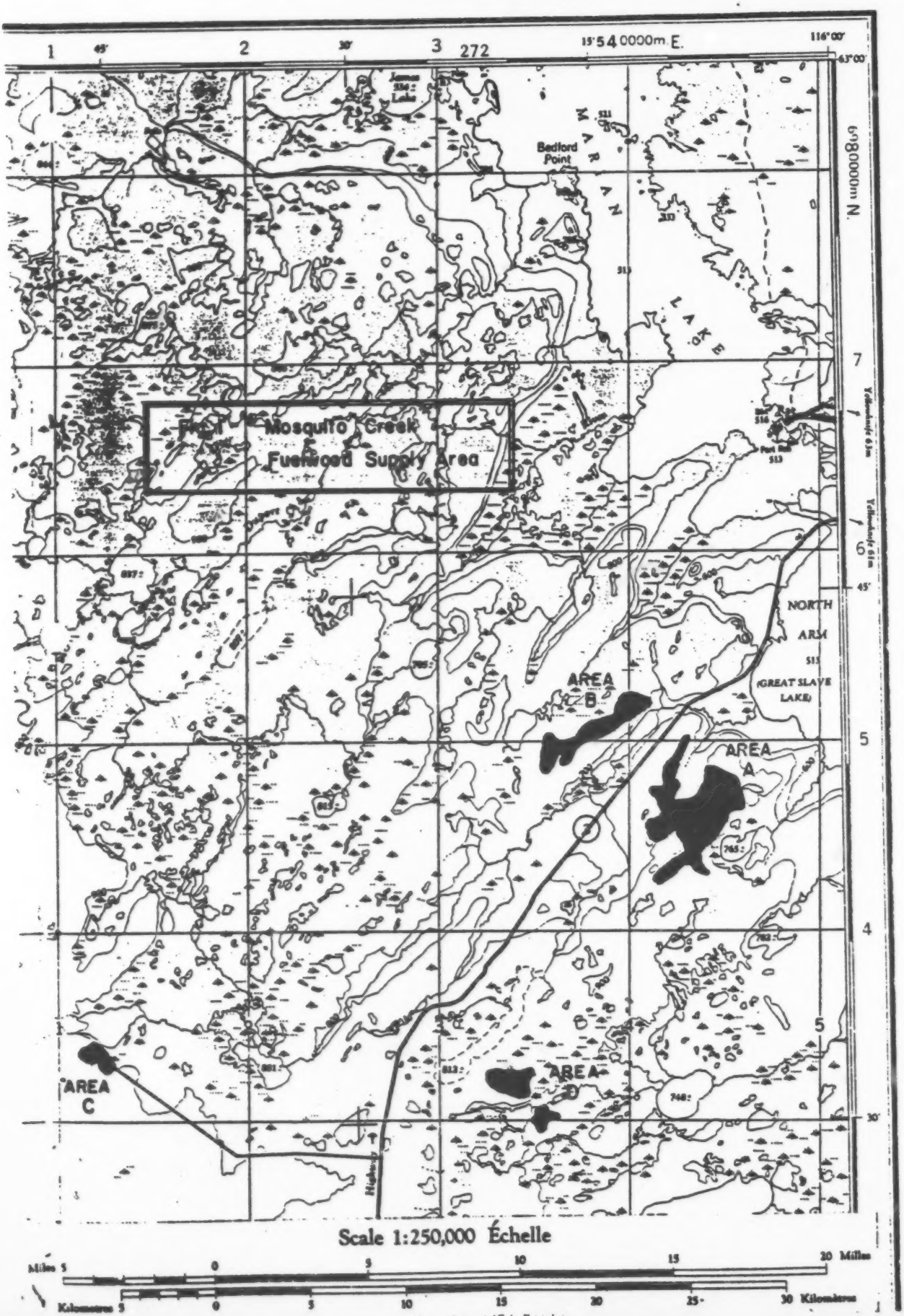
The map (fig. 1) on the preceding page shows the general location of the Mosquito Creek Fuelwood Supply Area. This area is approximately 20 km from Rae and 120 km from Yellowknife. Fuelwood Permittees (both free and commercial) from Rae, Edzo, and Yellowknife are presently cutting timber east of highway No. 3 and just west of "Area A". This unmanaged cutting has resulted in strained relations between the people of Rae and those of Yellowknife. There are allegations of stolen wood, road blockages and unpermitted harvesting taking place in the area, which in the interest of D.I.A.N.D.'s credibility alone, must be rectified.

Energy, Mines and Resources is presently entertaining a proposal for the conversion from oil to wood heat for two major buildings as well as many private homes in Rae. Such a conversion would substantially increase the fuelwood needs of Rae.

This report only identifies a finite wood supply resulting from the 1972 Mosquito Creek burn. However, should a wood heat conversion be implemented, a life-time wood supply for Rae will need to be secured. This will require proper forest cover maps (from aerial photos and their interpretation) and an extensive forest inventory.

FIELD SAMPLING

Field sampling was carried out by two staff members of the D.I.A.N.D. Timber Management office with logistical assistance provided by the Yellowknife District staff of D.I.A.N.D. After an initial aerial reconnaissance of the Mosquito Creek burn, only four harvestable jack pine areas were identified; these areas (A, B, C, & D) are indicated on figure 1. Apart from these four areas, the burn consists of very small black spruce, unsuitable for fuelwood harvest.


115°54'0000m E.
116°00'
63°00'
6980000m N.
Bedford Point
LAKE
Mosquito Creek
Fuelwood Supply Area
NORTH ARM
(GREAT SLAVE LAKE)
AREA B
AREA A
AREA C
AREA D
Scale 1:250,000 Échelle
Miles
Kilometres
Milles

Each of these areas was ground sampled using a relaskop (metric BAF 2) to indicate the trees to be measured. All standing trees, green and burned, greater than 10 cm at d.b.h. were tallied by species and d.b.h. Sixty heights and diameters were recorded to help establish a height/diameter curve needed for subsequent volume calculations. In all, 340 sample plots were measured over the 2669 ha of suitable fire-killed jack pine.

In addition to the sample plot measurements, field notes were kept regarding topography and road access to these areas. With the exception of "Area D", road access is quite straight forward, requiring few culverts and little gravel to provide reasonable year-round access. Access to "Area D", due to the distance from highway No. 3 and the swampy conditions needed to be overcome, should only be provided with winter access in order to keep road-building costs realistic.

Regeneration within the burn was observed to be satisfactorily stocked to over-stocked. It is our opinion that this well established regeneration will not be unduely disturbed provided "hand-logging" (non-mechanized) methods continue being practiced.

Occupation of the burn area by wildlife appeared minimal. However, recent woodland caribou tracks were observed throughout the burn area as well as evidence of hares, grouse and ptarmigan. With the present limited use of this burn being made by wildlife, we can assume that the activity of timber harvesting will have little detrimental effect upon them.

RESULTS

Reference to the Stand and Stock Tables for Areas A, B, C and D found in Appendix I, indicates that tree size and volume per hectare is substantially the same for all areas. The volume estimates shown were analysed statistically with a ± 15% "target" for the estimate of the mean volume at a 95% level of confidence in the mean. Samples taken for Areas A & B (229 plots) more than meet this criterion, while the 89 samples taken in Area D are adequate for the volume estimate in

this block. The 22 samples taken in Area C while not sufficient in number to give a statistical verification of the volume estimate for jack pine in this block, are deemed acceptable, since the estimate of 29.69 m^3/ha of jack pine differs little from the estimates of the other areas. However, Area C does appear to have about 50% of its volume concentrated on the smallest trees (10 cm - 12 cm). Table I, which follows, presents a summary of tree sizes and volumes per hectare contained in each Area.

Table I

Summary by Area - Number of Trees

and Volume per Hectare - Jack Pine Only

Diameters	No. Trees/ha			Volume m^3/ha		
cm	(A&B)	(C)	(D)	A&B	C	D
10	144	348*	157	6.5	14.7*	7.1
14	152	179	194	12.2	14.0	15.6
18	49	8	75	6.8	1.0	10.2
22+	19	-	14	4.4	-	3.2
Total	364	536	440	29.9	29.7	36.1

* Area C - majority volume of small diameters.

Assuming the volume estimates as shown are "good" (they should be) it must be pointed out that the yield from any area will not be met unless all trees down to 10 cm (approx. 4 inches) are harvested. The estimates are also based on utilizing all trees to a top of 6.0 cm or approximately 2.5 inches. It is evident from the above table that a tree length skidder, commonly used in harvesting larger timber, is not needed to harvest such small trees. Also, the attempted use of a skidder in these areas could heavilly damage the present regeneration of pine.

Table II presents the soft conversions of the cruised m^3(cubic metres) volume estimates to stacked m^3 and to cords. The total cordage by area is also shown.

Table II

Supply Area Volume Estimates

(Jack Pine Only)

Area	ha	Acres*	S/m^3** ha	Cords*** Acre	Total S/m^3	Volume Cords
A	1425	3519	48.6	5.5	69,255	19,355
B	802	1981	48.6	5.5	38,977	10,895
C	144	356	48.3	5.4	6,955	1,922
D	298	736	58.7	6.6	17,492	4,857

1. Conversions: * 1 ha = 2.47 acres.
   ** S/m^3 or 1.0 Stacked m^3 = 0.625 m^3.
   *** 3.6 S/m^3 = 1.0 cords.

2. Volume (cords) Area B, C, D = 17,674

3. Volume (cords) Area A = 19,355

Appendix 6.0

UNITS, CONSTANTS and CONVERSION FACTORS

Appendix 6.0 UNITS, CONSTANTS, and CONVERSION FACTORS

1.0 BASIC UNITS

1.1 DEFINITIONS

- 1 calorie (cal) = quantity of heat required to heat one gram of water 1°C
- 1 BTU (British Thermal Unit) = quantity of heat required to heat 1 lb. of water 1°F (from 59°F to 60°F at 1 atmosphere)
- 1 boiler horsepower = work required to evaporate 34½ lbs. of water per hour at 212°F to steam at 212°F
- Latent heat of vaporization of steam:
  at 212°F, 14.696 psi, = 970.3 BTU/lb
- 1 cord of wood = volume of neatly stacked logs of dimensions 4' x 4' x 8' long = typically 90 ft^3 of solid wood

1.2 CONVERSION FACTORS

- 1 h.p. (boiler) = 33,475 BTU/hr
- 1 calorie = 4.180 Joules
- 1 KCAL = 3.968 BTU
- 1 watt = 1 Joule/sec
- 1 BTU/hr = 1,055 Joules/hr = .293 watts
- 1 cord of wood = 90 ft^3 of solid wood
  = 108 ft^3 of chipped wood (Ref. 7)
  = 3.6 stacked m^3
- 1 US Gal/hr = 3.785 litres/hr
- 1 litre = .220 Imperial gal. = .264 US gal.

2.0 HEATING VALUES

- Light Fuel (Density = .88 Kg/l) = 18,056 BTU/lb
  = 10,031 KCAL/kg
  = 35,030 BTU/l
  = 159246 BTU/Imp. gal.

- Wood Fuel - air dry, 16.67% m.c., wet basis
  white spruce = 16.2 million BTU/cord
  jack pine = 21.6 million BTU/cord
  white pine = 17.1 million BTU/cord

POOR

QUALITY

ORIGINAL